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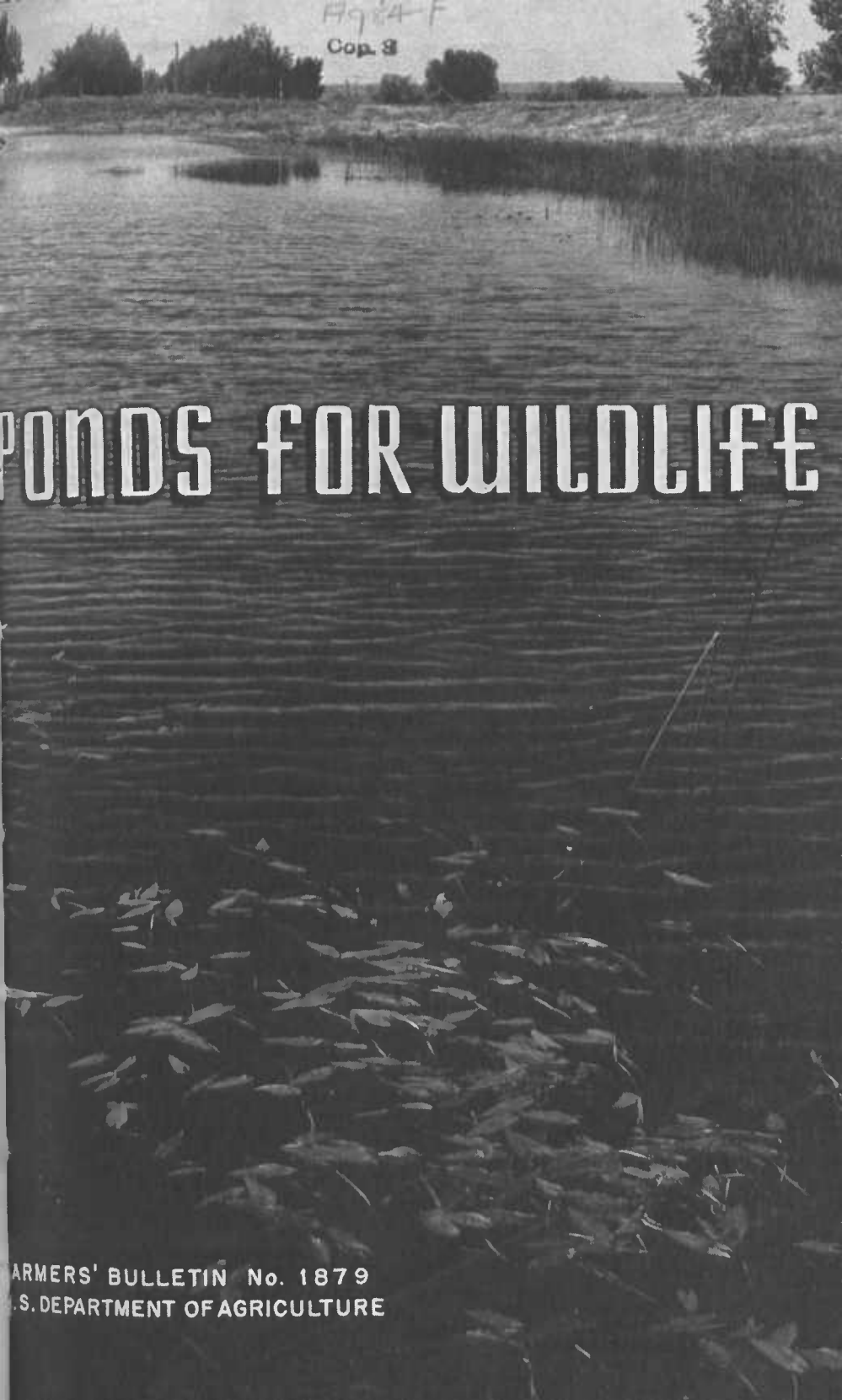

PONDS FOR WILDLIFE

FARMERS' BULLETIN No. 1879
U.S. DEPARTMENT OF AGRICULTURE

WATER areas, whether natural or constructed, provide homes for more species and more individuals of wildlife than comparable acreages of woodland, fields, or pasture. Even those species tolerant of arid conditions congregate wherever there is water. In the West, one is immediately impressed by the variety of animal life frequenting ponds. Eastern water areas are equally rich in birds, fur animals, and fish.

Those ponds and pond areas that provide the most suitable habitat for wildlife are those well protected by vegetation against the hazards of erosion.

The first purpose of this bulletin is to show how farmers and ranchers may protect their ponds from sedimentation, soil erosion, and water loss through the use of vegetation suitable as food and shelter for wildlife; the second is to give some information on the management of wildlife in farm ponds.

Unless otherwise stated, the information contained in this bulletin pertains to the water area, or pond proper, and the pond area, or the land immediately adjacent to the pond and ordinarily contained within a fence.

Washington, D. C. Issued July 1941

PONDS FOR WILDLIFE

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Contents

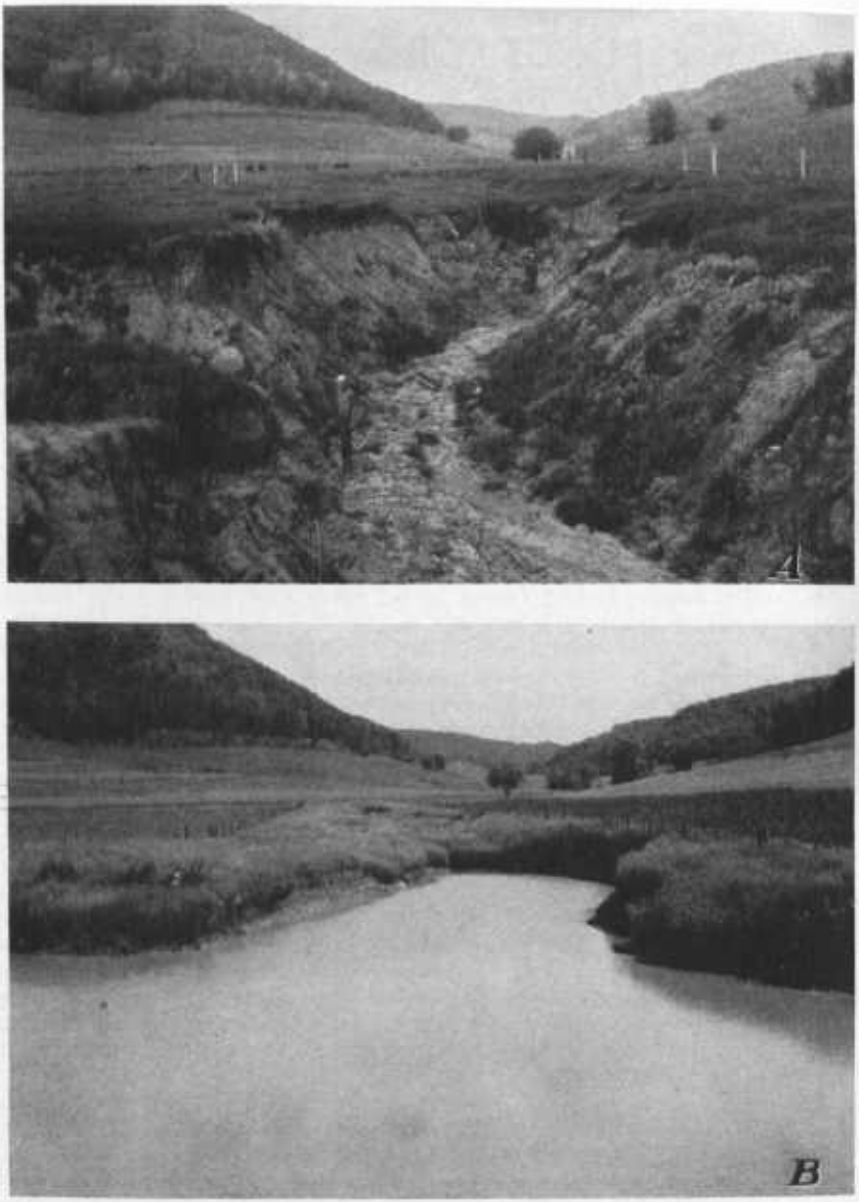
WHY HAVE A FARM POND?

WHETHER on western ranges, in small pastures of the East, or in the South, better farms mean more and better farm ponds. Better ponds make better farms.

Within the pond area are numerous products of the land that are more or less independent of surrounding areas. The harvesting of ice from a pond or the use of a pond for recreation or for the production of fish, waterfowl, and fur animals are examples of ways in which farm ponds may be employed on farms where the best use of all the land is the farmer's goal. Occasionally a pond serves such useful purposes as providing water for home consumption, maintaining springs, and subirrigating croplands.

A farm pond, also, may have a direct effect on the uses of other land on the farm. By helping to achieve proper distribution of grazing, the stock-watering pond aids in protecting vegetation on pasture and range. The impounding of waters in farm ponds may contribute to flood control. In some sections of the country water from farm ponds may be used for irrigating crops and establishing vegetation for erosion control. A pond may prevent gully heads from eating back into croplands or pastures (fig. 1) or keep silt from covering valuable land below it.

It is desirable to plan the average farm pond for several uses. The pond that controls a gully head may also provide the water for livestock. A pond for the control of water in the upper reaches of waterways may be planned also as a shelter to upland game birds. A pond for the storage of irrigation water may be made a suitable recreation spot for the farm family and neighbors. Pond areas make excellent locations for bee colonies, since many of the plants growing near ponds are honey producers. They are a source of wild fruits and nuts for home use. A wildflower garden by the farm pond may well rival in beauty the formal flower bed and pool of the city park. Lady-slipper, dogwood, smartweed, violets, and many other flowering plants may thrive on pond sites.



WIS 17A; WIS 17B

FIGURE 1.—A gullied area (*A*) may be made into a pond area (*B*) that supplies water for use on the farm and creates a place suitable for wildlife. Further growth of the gully has been stopped.

No pond should be used for the disposal of empty tin cans, garbage, or other waste, for such uses destroy the attractiveness of a pond, reduce its capacity, and make it unsanitary and unsuitable for wildlife (fig. 2). Botulism, a serious disease of waterfowl, livestock, and humans may result from such pollution.

Of the many uses to which farm ponds can be put, only one is considered in detail in this bulletin. The discussion pertains primarily to planning ponds for wildlife by measures that control erosion in pond

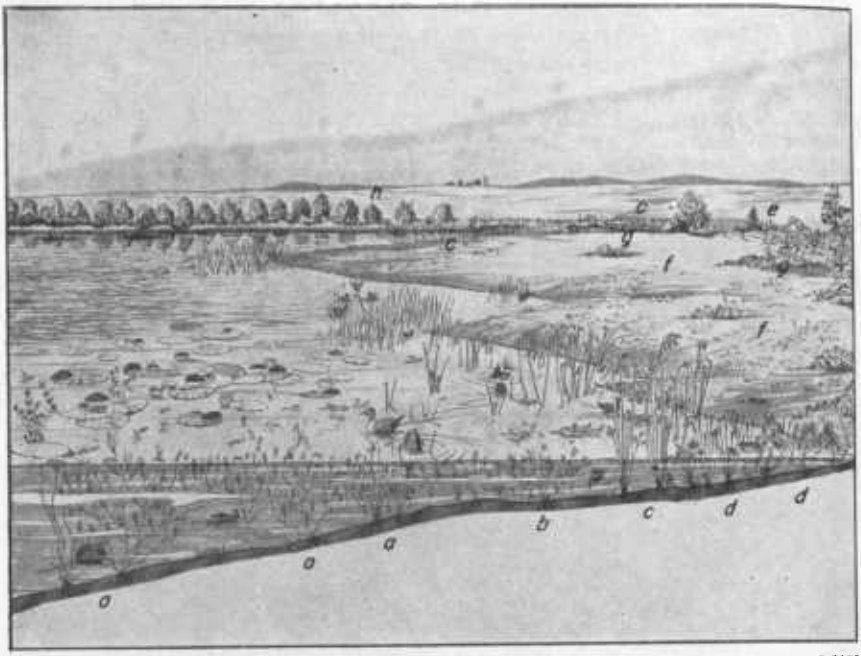
MINN 359

FIGURE 2.—Pollution of ponds destroys fish and other wildlife.

areas. The aquatic and marsh vegetation, grasses, herbs, trees, shrubs, and vines that protect the dam and shores of a pond from wave action, provide an impediment to the flow of silt into the pond and prevent erosion on land immediately surrounding the pond. Also, wild animals usually make their homes in the vegetation of the pond area. The amount and kind of vegetation around ponds usually govern the degree of erosion in the pond area and the abundance of wildlife thereabouts.[1] Making plans for planting the farm pond is therefore one of the first requirements in building ponds for wildlife and erosion control (fig. 3).

[1] In the South, and particularly in the Southeast, the presence of marsh and aquatic plants in the pond is conducive to the breeding of certain species of malaria-carrying and other pest mosquitoes. Often the major problem in those areas is not the establishment of vegetation but its control. For that reason dense and floating vegetation may be undesirable in southern ponds. Keeping pond edges free from emergent vegetation is an important step in preventing mosquito breeding where these insects are serious.

To prevent the spread of malaria, most of the Southern States have laws and regulations pertaining to the construction and management of farm ponds. Ponds should not be constructed or developed for wildlife without reference to those laws. It is extremely important that no vegetation that protects the larvae of malaria-carrying mosquitoes be permitted to develop. Fish, particularly the gambusia minnows, are efficient in controlling mosquitoes when they are able to get at the larvae.



C-8053

FIGURE 3.—Plantings for a farm pond: Principally submerged plants (*a*), such as horned pondweed or ornamentals (for example, waterlilies) are most useful for waterfowl and fish, but are less valuable for protecting pond shores. Floating-leaved species of plants (*b*), such as longleaf pondweed, act as oil does in reducing wave action. Sedges and rushes (*c*) hold sediment and prevent the deeper parts of the pond from filling. They also present a barrier to wave action on shores or dams. Arrowheads, spikerushes, and three-square rushes (*d*) form a cover of vegetation on shores and dams, helping to prevent erosion from water flow from above as well as from wave action on the pond. Woody plants (*e*) in the upper parts of the inlet and in gullies halt the flow of silt into a pond. A ground cover of grasses or legumes (*f*) protects the upland adjacent to the shores and provides nesting sites for waterfowl. Small clumps of trees and shrubs (*g*) are used by wildlife for shelter, and the fruits provide food. The windbreak (*h*) protects the pond by reducing wave action and also provides shelter for wildlife.

PLANNING FARM PONDS AS SUITABLE WILDLIFE HABITATS

LOCATION AND CONSTRUCTION

Ponds should be located where they will not be polluted from barnyards, sawmills, or mine dumps. Pond areas should be near good permanent cover such as that in woodland or canyons. Fence rows or hedges of dense vegetation leading into the pond area are desirable. The location of the pond makes a difference in the kinds of wildlife that frequent the pond. Ponds near the upper end of drainageways may create conditions suitable for waterfowl and satisfactory for the shelter of upland game birds. Ponds in lowlands usually prove attractive to fur animals.

The actual construction of farm ponds is fully treated in Farmers' Bulletin 1859, Stock-Water Developments: Wells, Springs, and Ponds.

Plans for the improvement of ponds and pond areas for wildlife use ordinarily should preeede the construction of the pond, for certain structural features that cannot be obtained after the pond is built may be desirable. Among such improvements are the construction of spawning beds and shelters for fish, the digging of pools, the creation of small islands, and the sloping of steep shores (pp. 37–38).

Precautions against ice hazards may also be taken while the pond is under construction espeeially in the North. The thrust of iee against a dam may cause cracking and washing. Ordinarily the danger to the dam is less in a large, deep pond than in a small, shallow one. Steep banks increase ice hazards. The openings of pipes that enter the pond should be deep enough to prevent freezing, and the piping itself should be buried in the soil below the dam if there is danger from frost. In shallow ponds that freeze to the bottom the ice may uproot aquatic plants.

After the pond has been completed, as well as at the time of eonstruction, it is important to guard against iee hazards. No obstruetions should be allowed in the spillway to halt the passage of iee, for the accumulation of iee in spillways may reduce their eapaeity and cause them to wash out.

FENCING PONDS AND POND AREAS

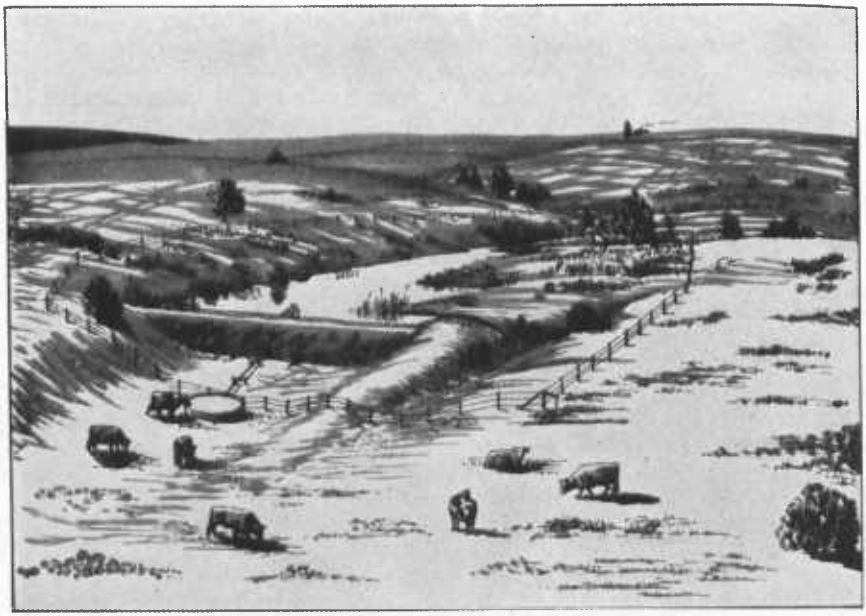
Under ordinary eonditions the fencing of the pond area is the first step in protecting a pond from erosion and silt. Usually the fencing is one of three types, namely: (1) Complete enclosure of the pond area within a single fenee; (2) separate enclosure of two parts of the pond, with the dam, spillway, and a portion of the lower drainage within one fence and the upper reaches of the pond in another; and (3) enclosure of only the upper part of the pond and a part of the upper drainage.

In each of these three types of fencing a sufficient area in the upper drainage should be ineluded within the fenee to insure that the vegetation will develop suffieiently to serve as a silt trap.

Complete Fencing of the Pond Area

Complete fencing is most desirable for proteetion of the pond, and the fencing should be of this type exeept where the pond is below the general ground level, so that the use of piping is impractieal, or where freezing precludes the use of a float valve and piping. Livestoek may be watered at a tank below the dam; this reduces the opportunity for livestoek to beeome infested with internal parasites or infeeted with such diseases as anthrax. Not only does complete fencing permit adequate proteetion for the pond itself, but it insures a elean supply of water for livestoek (fig. 4), provided, of course, the original souree of water is not polluted. If the water supplies domestic needs, the pond should always be completely fenced, and the water supply should be checked to insure freedom from pollution.

Stock trails leading down steep slopes usually result in serious gullies. Careful seleetion should be made of the site where cattle are watered, and fencing should be done so as to bring the livestock to water on a slope of low gradient. By piping the water to a tank



C-8054

FIGURE 4.—Complete fencing of ponds has many advantages, especially if vegetation is used in and around the pond. Water is supplied to livestock by a tank below the dam.

NM 10453

FIGURE 5.—The steps in this tank permit the escape of wildlife that may fall in. This type of construction is a sanitary measure as well as one for the protection of wildlife.

located where the danger of gullying is slight this hazard may be reduced.

In concrete tanks used for watering livestock below the dam, a step or ramp at one end may permit the escape of birds or other wildlife that accidentally fall in (fig. 5). By such means lambs or other small livestock may also save themselves. This ramp is not only a measure for the protection of wildlife; it also prevents fouling of the tank. A small board float or a board ramp with cleats serves the same purpose in a metal or wooden tank.

Complete fencing permits the growth of natural or planted vegetation by preventing grazing and trampling by livestock. Marsh plants may be established around the shores of the pond. Bush willows or rushes may be grown on the dam, and aquatic plants thrive better in the clearer water. The fencing of the pond, likewise, is essential for the protection of windbreaks, post lots, and other plantings within the pond area.

Separate Fencing of Two Areas

Where broad, gentle slopes lie adjacent to the deeper parts of the pond and where complete fencing is impracticable, areas at both ends of the pond may be separately fenced (fig. 6). Enclosing the dam, spillway, and a part of the lower drainage within one fence and the upper part of the pond and adjacent drainageway within a second leaves a wide opening on both sides of the pond where livestock may water. Such openings should be at least 50 feet wide if 10 or more head of livestock use the pond. This width will prevent crowding and injury or drowning of the weaker animals. For most small ponds, 100-foot gaps should be the maximum necessary to enable the livestock to use the water. In some localities the watering area is paved to prevent bogging and to eliminate gullying.

It is necessary to include within the fence enclosing the dam and lower drainageway an area sufficient to insure the stability of the drainageway. Either plantings or natural vegetation may be established to prevent gully heads from cutting into the dam. It is particularly desirable to have overflow spillways well vegetated and to encourage the growth of vegetation on the banks of the drainageway downstream.

Fencing Part of the Pond and the Upper Drainage Area

The third type of fencing is especially adapted to very small pond areas or sites where other types of fencing are impossible. Only the upper part of the pond and adjacent drainageway is fenced. On smaller ponds one-fourth to one-third of the water area at the average level should be enclosed; on larger ponds one-half or more of the pond may be fenced.

It should be remembered that wherever livestock has access to pond water, the purity of the water should be safeguarded. It is inadvisable, for example, to apply manure to the water or shores to encourage the growth of aquatic plants if livestock is to use the water. The necessity of safeguarding the purity of water for domestic needs is obvious.

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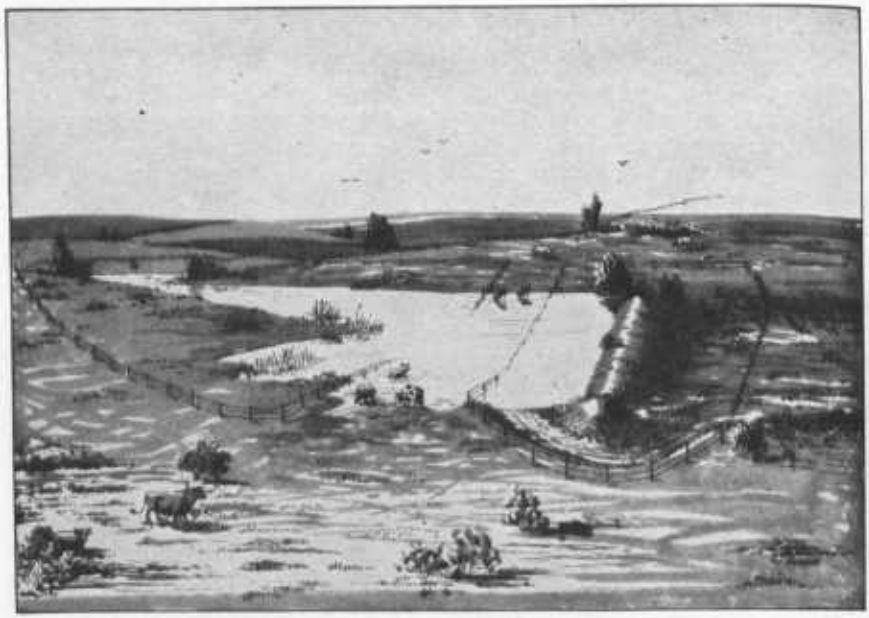


C-8058

FIGURE 6.—A gap in the fence leaves the pond accessible to livestock. A part of the pond thus serves as a substitute for a tank.

USING VEGETATION TO MINIMIZE EROSION HAZARDS

Erosion Hazards to Ponds

The accumulation of silt in farm and ranch ponds is one of the most serious hazards to ponds. Since silt deposits are often out of sight, they are not always evident until the pond is badly damaged. A single rain may bring as much as 2 or 3 feet of silt into a pond. Within 1 or 2 years the capacity of some ponds has been reduced so greatly as to render them completely useless (fig. 7).

The greater part of silt deposited in ponds comes from adjacent land and pours into the pond from every rill and gully in that land. Wave action causes the deposition of silt from the dam and shores. The stabilization of the soil on all the land in the watershed above the pond and a complete cover of vegetation on the dam are of paramount importance.

If possible, fields immediately surrounding the pond area should be in grass, trees, or shrubs. Crop fields may be treated by terracing, strip cropping, contour farming, or other measures designed to conserve the soil and prevent rapid run-off of water. It is especially desirable to stabilize with suitable vegetation or by other means all gullies contributing to the pond. Vegetation along shore lines may prevent the deposition of silt in the deeper portions of the pond.

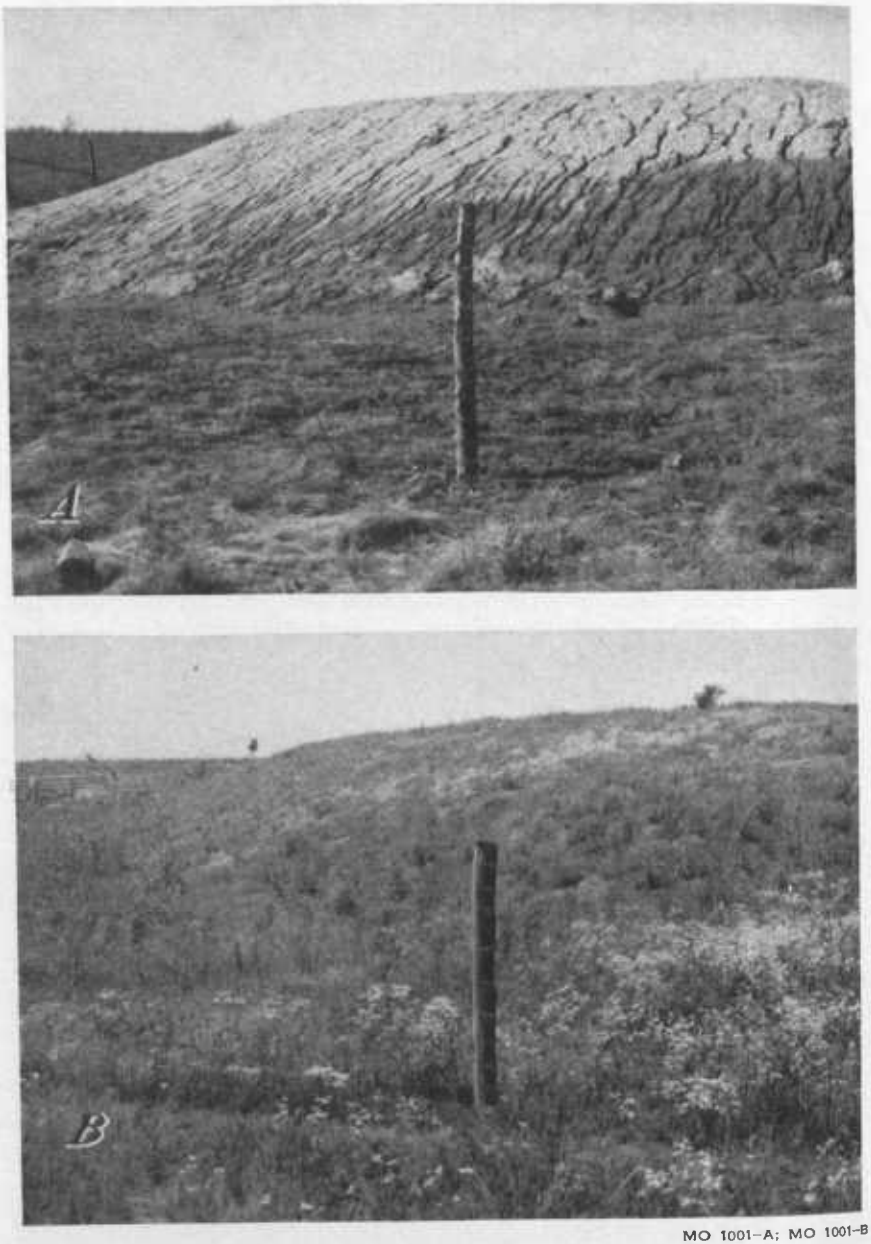
If inflow of silt is greater than can be held by vegetation, it is sometimes necessary to provide silt basins above the pond. These

TEX 50282

FIGURE 7.—The capacity of this pond has been seriously reduced by sediment deposits.

COLO 6099

FIGURE 8.—Wave action is one of the most serious hazards to bare earthen dams.



MO 1001-A; MO 1001-B

FIGURE 9.—*A*, A portion of an unvegetated dam, showing the rills formed after a rain; *B*, the same dam protected by mulching and seeding with grass.

are pools where incoming water is slowed sufficiently to allow deposition of silt. The advice of an engineer should be sought for aid in the location and construction of silt basins.

Waves on even the smallest pond endanger earthen dams and shores (fig. 8). The lapping of small ripples will erode dams rapidly. Large waves may tear down a dam in a few hours, for water has tremendous power. Unless there is a buffer to cushion the pounding of waves and absorb the strength of their return, soil quickly sloughs from the face of the dam, and eventually a break is made. The planting of marsh and aquatic plants is one of the best means of combating this hazard.

The absence of vegetation on dams exposes unprotected soil to rainfall, and sheet erosion on the dam often results. Sheet erosion leads to rilling, which may cause a break in the dam if it becomes serious enough (fig. 9). A complete cover of vegetation is essential to the stability of the earthen dam.

Establishing Vegetation

Ponds and pond areas need not always be planted to establish vegetation. The site of a prospective pond frequently is already well covered with plants, and the drainageway may contain species of plants adapted to the stabilization of the shores. It is necessary only to give such ponds protection from livestock in order to permit the spread of plants around the water's edge. Even aquatic plants, the presence of which is unsuspected, may suddenly appear in the pond shortly after its completion.

Natural development of vegetation follows an orderly process. Step by step the vegetation progresses from the lower plants, such as green scum, through the annual grasses and herbs to the perennial plants—the rushes, sedges, and perennial grasses. When water and soil conditions are favorable, this succession of plants may take place in 1 to 2 years, but sometimes 5 to 10 years pass before the final stages are reached.

TEX 1416

FIGURE 10.—Protection of the shores from livestock is the only expense when nature does the planting.

Farmers and ranchers may have difficulty in determining whether the pond should be planted or permitted to develop its vegetation naturally. If marsh and aquatic plants are abundant in the imme-

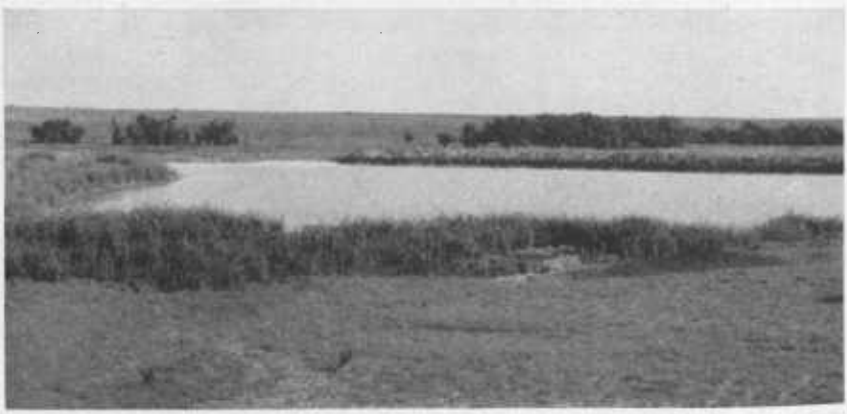
diate vicinity of the pond, especially in its watershed, or if above the new pond there are older ponds where these plants already grow, it is perhaps unnecessary to plant. These conditions are common in the southern part of the country (fig. 10), and there are also such sites in the Northeast. From the Midwest progressively westward, throughout the drier parts of the country, the need for planting ponds and pond areas becomes greater. The principal advantage of planting over natural plant growth is that the plant species desired can be established more quickly. Likewise it is sometimes advisable to establish a particular species on a specific location. For example, the establishment of bulrushes on a dam may be necessary to prevent waves from cutting the dam.

The principles discussed for marsh and aquatic plants are applicable to plants for the upland. If it is not necessary to plant for the protection of the upland or if there is no other immediate need for a cover of vegetation, the protected area may be left unplanted. Natural vegetation composed of the native plants of the vicinity will develop. Here, again, determination of the need and of the species desired governs the practice.

VEGETATION FOR THE POND AND POND AREA

PLANTS FOR THE POND SHORE AND BOTTOM

Marsh plants are those that grow in mud or shallow water most of the year but may endure flooding for hours or days, and when the water level recedes and rains are infrequent can survive droughty conditions. These shore-line plants serve a threefold purpose in pond protection. They provide a ground cover for the protection of the shores from erosion, they act as a barrier to wave action, and they are an impediment to the flow of silt (fig. 11). At the inlets, barriers of marsh plants slow the inflow of silt-laden water, which causes deposition of silt, sometimes as much as 2 to 3 feet a year. Species that form dense tangles or mats are especially valuable as silt barriers and wave breakers.



COLO 255

FIGURE 11.—Silt is held at the inlet of the pond by a good growth of smartweed and sunflower, both excellent wildlife food plants.

Most of the marsh plants provide a considerable amount of food and shelter for wildlife, although their ability to do so varies with seasons and plant species (fig. 12). It is, therefore advisable to plant two or more species to insure the greatest protection to the pond and supplies adequate to the needs of wildlife. As pointed out in the discussion of plant groups (pp. 20–31), the food, shelter, erosion-control values, domestic uses, and aggressiveness of various plants differ considerably. The needs at any pond should guide the selection.

MO 1137

FIGURE 12.—A combination of species of marsh plants offers greater variety of foods for wildlife and usually stabilizes the shore better than a single species. Here are arrowhead, spikerush, burreed, and pondweed.

Among the plants most used for pond banks are reeds, sedges, rushes, grasses, herbs, and shrubs. In nature these are the plants that inhabit such sites, and planting them merely simulates the natural process and perhaps hastens the achievement of complete protection for banks that natural plant growth would finally attain.

Truly aquatic plants and the marsh plants that grow in the water are particularly valuable because they reduce the waves before they reach the shore. The species that reach only to the surface act as oil does in diminishing the size of waves. Those that reach above the surface present barriers to the waves (fig. 13). Many of these plants provide food for waterfowl and muskrats. Some are believed to be beneficial to fish in oxygenating the water, reducing its roiliness, and providing food for insects, worms, and other small animals on which fish feed.

Several of these plants are ornamental, particularly the waterlilies. Others have various economic values. Many species are tolerant of a wide range of water conditions, and they often are widely distributed. With the exception of a few species, those discussed in this bulletin are generally widely distributed. Species that are very prolific and sometimes become pests are noted as having this characteristic. Other qualities of the plants are also discussed.

TEX 1419

FIGURE 13.—Aquatic plants, such as the longleaf pondweed shown here, reduce wave action.

Planting Methods

Plantings of the plant parts listed under the heading Propagation on pages 21–31 may be made by any of the following methods that appear most feasible for the pond in question.

The planting of rootstocks and tubers is the surest method of establishing those species that bear these parts. Marsh plants put in above the water level may be planted in spade holes in the mud. This also is most satisfactory in the water to depths readily workable. However, in water from 1 to 3 feet deep the tubers or rootstocks may be embedded in a moist mud ball, preferably wrapped lightly with cheesecloth and dropped into the water at 8- to 10-foot intervals. The best spacing of plants near the shore depends to a great extent on the erosion hazard. Where that is serious, it may be necessary to plant rows of marsh plants as closely spaced as 6 inches. Where there is no immediate hazard, spacing of 8 to 10 feet may be satisfactory.

ILL 841

FIGURE 14.—Log booms may be necessary to protect the dam until vegetation becomes established.

Many of the marsh and aquatic plants are readily propagated from seed. After the seeds have been thoroughly soaked they may be broadcast over the water surface and shore. Those planted above the water level should be raked or harrowed in and should run in rows parallel to the water's edge.

Cuttings, balled in mud, sometimes are used to propagate marsh plants. The large end of the cutting should be packed in the mud ball and the ball planted in the same manner as are those in which tubers and rootstocks are embedded.

Occasionally the whole plant may be used for transplanting. Pondweeds are sometimes handled in this way. The plants are lightly wrapped around a small stone, loosely tied in place, and dropped into the selected spot. Winter buds and leafy stems of aquatic plants may be planted in this way or partly embedded in mud balls.

Unless a shore or dam must be immediately stabilized only enough plants to assure their establishment should be obtained. From 10 to 100 plants will often be enough to stock the pond.

The seeds of aquatic plants may do better if broadcast in the fall and allowed to lie over during the winter. As a general rule, too, the sooner plantings are made after the planting stock is collected, the greater the chance of success.[2]

To establish vegetation on dams, particularly in areas having fluctuating surface levels, it may be necessary to provide log booms to protect the dams from wave action (fig. 14). The boom needs to be used only until the plants have stabilized the dam. Booms may be constructed of any logs available, fastened end to end, and anchored to the shore at each end of the boom a distance of 4 to 6 feet from the dam.[3]

VEGETATION FOR THE UPLAND

Areas within the fence but above the shores and immediately adjacent to the pond often are bare or have very sparse vegetation because the soil is infertile. Unless these lands are to contribute silt to the pond they require a plant cover. Herbaceous vegetation such as grasses, legumes, and other nonwoody plants may be used to good advantage here as well as on the bare earthen dam (fig. 15). Thickets of shrubs and rows of trees also help to control erosion on such sites.

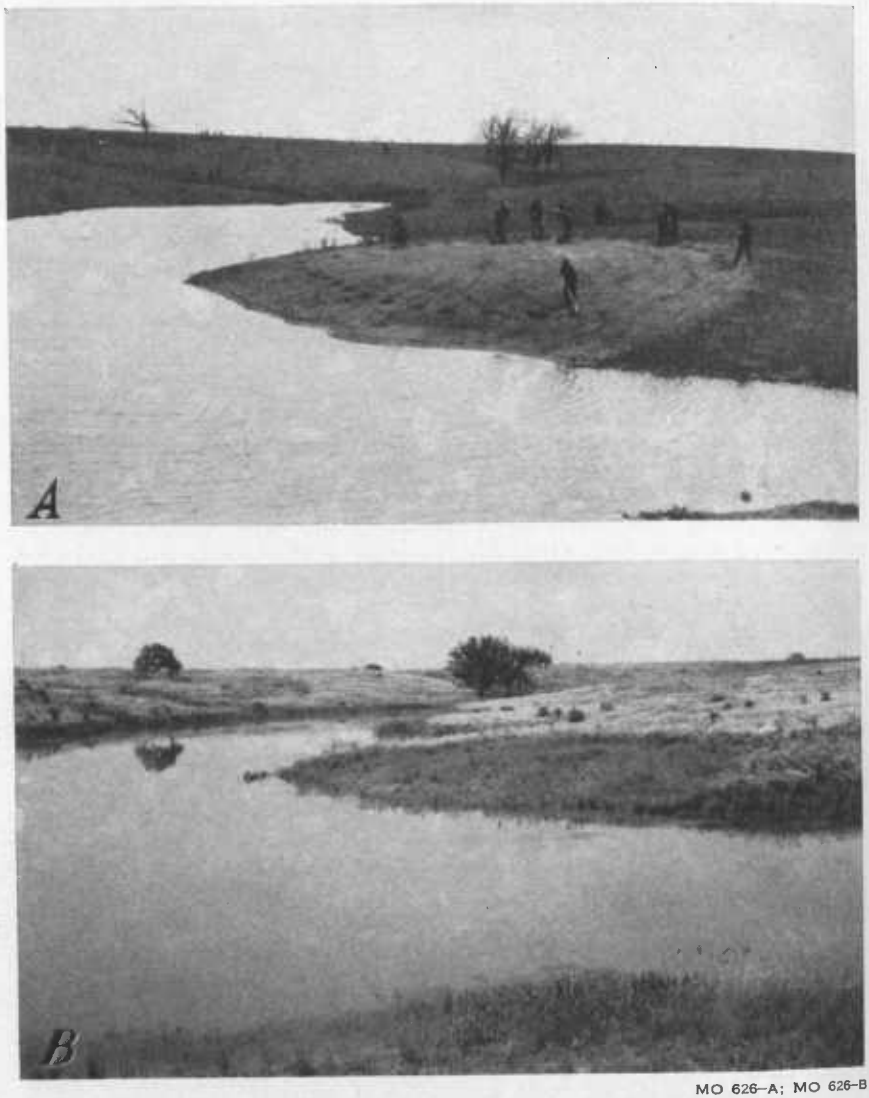
For most rapidly covering the ground, seeding is considered the best method of establishing nonwoody species. The time and rates of seeding of grasses and legumes should follow recommendations of the nearest State agricultural college and extension service office. Often a quick cover can be obtained by sowing millet or Sudan grass the first year. A companion crop of small grain, sowed thin, may be advisable. Usually mixtures are better than seedings of one species only. Any stirring of the ground to cover the seed should be on the

[2] For more detailed information on securing, handling, and planting aquatic and marsh plants see U. S. Dept. Agr. Tech. Bull. 634, Food of Game Ducks in the United States and Canada.

[3] A common method of protecting earthen dams is by means of rock riprapping. This often is advisable if there is a convenient and inexpensive source of rocks and if it is impossible to protect plantings on the dam or to be assured of their growth. Ponds having wide variations in water-surface levels often require riprapping. In windy areas ponds of large surface acreage (5 acres and more) or long and narrow ponds that lie parallel to the prevailing wind almost invariably require more than vegetation to protect them from wave action. One disadvantage in the practice of riprapping lies in the attractiveness of loose rocks to burrowing animals, such as the pocket gopher.

302669°—41——3

contour. Where practicable, manure and waste vegetation such as straw, old hay, leaves, and even brush can be used as a mulch to good advantage. The use of commercial fertilizers is also advisable if the expense is not too great. To hasten the development of natural



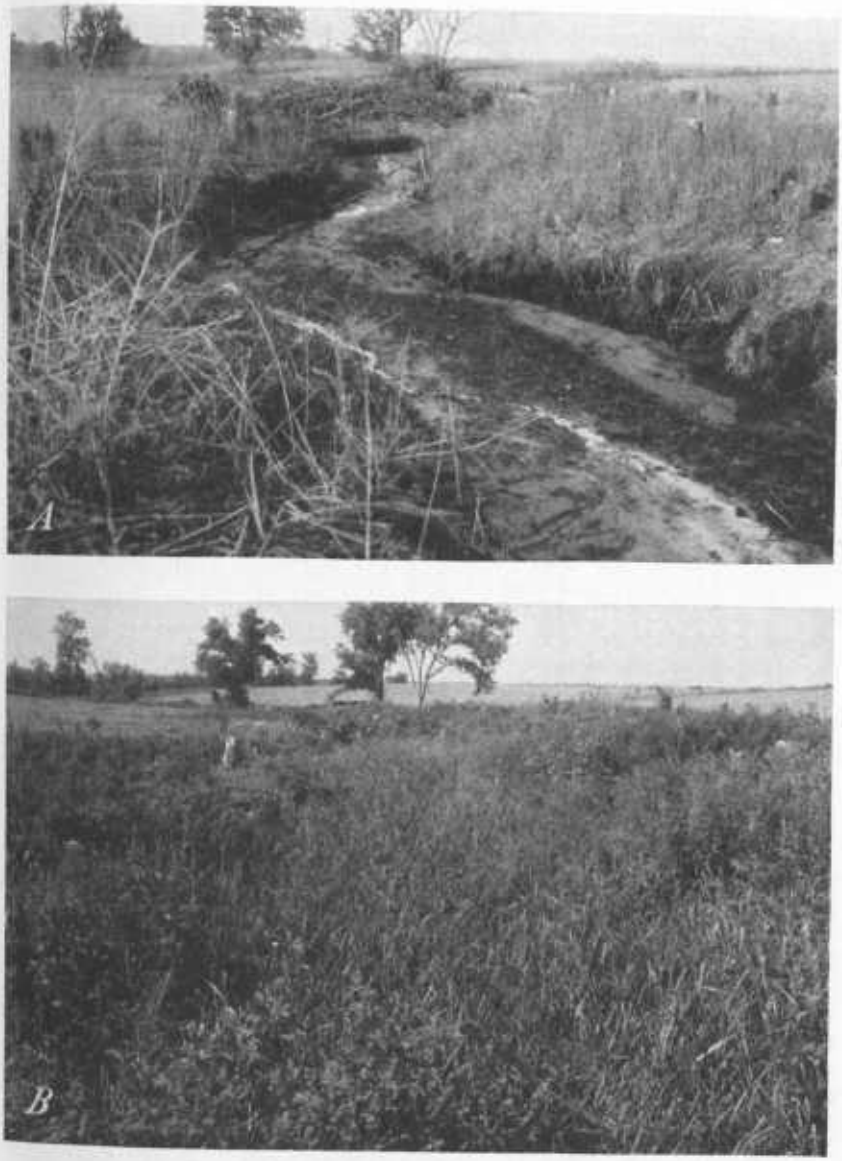
MO 626–A; MO 626–B

FIGURE 15.—*A*, Protecting the upland helps to keep silt out of the pond. A good ground cover of grasses, legumes, or shrubs provides nesting sites for waterfowl and songbirds. *B*, The same site well stabilized.

vegetation, mulching, manuring, and stirring of the ground may be useful, even though no seeding is done.

Manure, of course, should not be used if the pond water is made available to livestock for drinking or is used for human consumption.

Frequently there are active gullies within this area. Where such gullies enter the pond or the drainageway below it (fig. 16), it is sometimes advisable to put in plantings for their control. First, the re-



MO 398-A; MO 398-B

FIGURE 16.—*A*, The drainageway below the pond needs a cover of vegetation. *B*, the gully shown in *A*, protected by grass, weeds, and shrubs.

moval of the surface run-off from the area contributing to the gully is desirable. This may be accomplished by terracing, contour furrowing, or constructing diversions. It is sometimes necessary to build

check dams to assure the successful establishment of vegetation. These may be built of brush, wire, rock, logs, or other materials.[4]

Ordinarily the ultimate cure of a gully lies in the establishment of trees, shrubs, herbs, and grasses within the eroding area. The denser growing species present a barrier to the flow of water, and the sparser ones lay down a litter of absorptive leaves, twigs, and bark, which acts as a sponge to hold water where it falls. On small gullies, sloping the banks and seeding or planting them with grasses, legumes, shrubs, and trees may suffice if there is some chance of establishing this vegetation. On large gullies, trees, shrubs, and vines are often planted so as to aid in the natural establishment of herbaceous plants. Under these conditions it is usually customary to plant several rows of shrubs in belts across the gully, with more widely spaced trees between the belts of shrubs. The shrubs are closely spaced and are often planted in a crescent whose horns point upstream and run up the banks on both sides. The gully banks may be planted in belts parallel with the gully bottom, or plants may be scattered wherever a planting site affords opportunity for growth. Vines are planted at the foot or top of steep banks.[5]

Planting Methods

Wilding stock of many of the woody plants most suitable for the pond area is available on many farms. Either seedlings, root cuttings, or softwood cuttings may be prepared for transplanting. In moving seedlings it is important that the roots be kept moist during the entire period of handling. Wildings of some species do not survive transplanting because of the difficulty of obtaining feeder roots. The feeder roots may be several feet from the main stem of the plant. The seeds of some woody plants, such as walnuts, hazel, and blackberry, may be planted directly, and most of them can be produced in small numbers from seed in the vegetable garden and transplanted in 1 to 2 years.

Care should be exercised in planting. Each seedling should be put in a hole deep enough to enable the roots to hang straight down and wide enough to prevent crowding of the roots. The earth should be firmly packed and tamped. Shrubs and vines may be spaced from 1 to 6 feet apart depending on the species and site. Trees may require a spacing of 6 to 15 feet. In semiarid areas the irrigation of trees is necessary. It is often desirable to divert water to the tree site from the pond or its contributing area. By developing a site on the pattern of a sirup pan, that is, in zigzag fashion, the water may be conducted slowly from tree to tree. Trees should be kept free of weeds long enough to permit their growth above the herbaceous plants.[6]

As a general rule, cover plantings are made in fairly dense clumps to obtain effective cover quickly (fig. 17). Spacings are usually 2

[4] Farmers' Bulletin 1813, Prevention and Control of Gullies, gives instructions on how to stabilize gullies.

[5] Farmers' Bulletins 1788, Wildlife Conservation Through Erosion Control in the Piedmont, and 1813, Prevention and Control of Gullies, give methods of planting gullies, and U. S. Dept. Agr. Cir. 412, Groups of Plants Valuable for Wildlife Utilization and Erosion Control, gives a list of plants used for stabilizing gullies.

[6] See Farmers' Bulletins 1123, Growing and Planting Hardwood Seedlings on the Farm, and 1567, Propagation of Trees and Shrubs.

feet square for small shrubs and plants, and 4 feet square for larger shrubs. Food plantings of woody species, on the other hand, are spread farther apart to allow more profuse fruiting, seeding, or vegetative growth on individual plants at an early age.

MO 974-A; MO 974-B

FIGURE 17.—*A*, A Missouri pond before the shore was stabilized and developed for wildlife. *B*, The site shown in *A*. The shores have been protected with rushes, and the shrubs in the background provide wildlife food and shelter.

It is often necessary to "scalp" or clear planting sites by hand or with a plow before planting shrubs or trees and to cultivate plants for one or two seasons to protect them against competition from other plants and provide more moisture storage. Other treatments to obtain more satisfactory survival may include the use of dead plant material or strawy manure as a mulch and the application of fertilizer on very sterile land.

Woody plants are planted during either the fall or spring, when the foliage is dead or the plant is dormant. Spring plantings seem to have a few advantages over fall plantings.

PLANT GROUPS USEFUL IN POND AREAS

A number of publications are available on plants for upland areas. These publications give information on the site requirements and methods of plantings. The following discussion does not cover in detail those groups listed on p. 31 under the heading Woody and Herbaceous Plants for the Upland. The marsh and aquatic plant groups, which are less well known, are discussed more completely.

Some plants are hazardous to the pond. In the West, trees should not be permitted to grow on small dams. Cottonwoods and tree willows are likely to be wind-thrown, and large holes are then left in the dam. Spillways should be kept free of trees, shrubs, and weeds. These plants may obstruct the flow of water through the spillway, causing it to fill with silt or to erode. Certain species of marsh and aquatic plants are objectionable in the pond and should not be introduced, or, if present, should be kept under control. Cattails should not be encouraged on ponds unless 80 percent or more of the area is

IA 50034

FIGURE 18.—Lotus, one of the species of plants aggressive in farm ponds, may become overabundant.

more than 3 feet deep. Cutting them with a scythe twice a year will control their growth. Among the other plants that may become objectionable are bladderworts, sago pondweed, waterweeds, coontail, white water buttercup, waterlilies, and watermilfoil (fig. 18). Periodic cleaning of the pond by means of a cable or barbed wire pulled in an arc through the water helps to control these plants. This method may also be used to free the pond from drift debris that may blow in and tend to fill small ponds. It is sometimes necessary to mow coarse grasses, reeds, and burreed.

The plants that are recommended in this bulletin (1) reduce wave action and cause the deposition of sediment, (2) have high wildlife values, and (3) are useful as medicine and food. Most of the groups are closely related species, although some contain two or more genera. Thus, pondweeds include plants of four genera: *Potamogeton* (for example, sago pondweed), *Ruppia* (wigeongrass), *Zannichellia* (horned pondweed), and *Najas* (bushy pondweeds or naiads).

SHRUBS

A few water-loving shrubs should be used around a pond. They form a nesting and perching place for many birds, provide needed shade for fish, help to hold down wave action, and attract many insects that are useful as fish food, especially at flowering time. Many of these species are also sources of berries and seeds.

Buttonball Bush (Buttonbush, Button-willow)

This plant is commonly found in suitable locations in most of the northeastern and southeastern United States, and it ranges sparsely over most of the rest of the country. It grows best on fertile sites at the water's edge that are neither very acid nor very alkaline. It may grow into a small tree. Its fruit is eaten by 17 species of ducks.

Propagation: Seeds, seedlings, or cuttings.

Dogwoods (Cornels)

Red-osier and silky cornel are most abundant in the Northeastern and Southeastern States. Roughleaf cornel grows well in the Central States and creek dogwood and other species are native to the Western and Pacific Coast States. These shrubs are usually more valuable for preventing erosion in pond inlets than buttonbush because they usually spread more rapidly and form thicker clumps. Their fruit is eaten by nearly all species of game birds and many other kinds of wildlife, including fur bearers. They may be planted on fairly acid soils of medium fertility. Plants may spread by the rooting of stem tips.

Propagation: Seedlings, cuttings, or seed.

Elders

Some one species of elder is found almost everywhere in the United States. As elders usually grow vigorously in moist but well-drained soil they are useful in pond inlets above the usual water line. They will grow in slightly acid soils. They offer obstruction to silt above a pond and provide good summer cover and excellent summer and fall food for wildlife. A total of 111 birds and many mammals, such as

rabbits and deer, feed on elder. The American elder is most commonly used. The fruits are useful in making jellies and wine.

Propagation: Root cuttings, softwood cuttings, seedlings, or seed.

Willows

Willows are very common in the United States. Around pond areas in the East they should be restricted mainly to the inlets some distance above the pond and should not be allowed to grow around the pond itself. In the drier parts of the country the bush willows are useful as wave breakers on dams. Sandbar, Bebb, and black willows are recommended. The buds provide a large amount of food for upland game birds. Willows are eaten by deer, rabbits, and beaver. They are excellent shelter plants.

Propagation: Cuttings or wilding plants.

HERBACEOUS MARSH PLANTS

Cattails

The common cattail is well known. Its range and that of its relatives cover the United States. Cattails increase rapidly when introduced in most ponds. Their introduction is recommended only where no other plant can be substituted or where heavy silting or other conditions make it impossible to use other marsh plants. The cattail is an excellent muskrat food, and the houses of muskrats are often composed of cattails. Geese feed on the rootstocks and leaves. This plant provides nest sites for marsh birds. Cattails often are used for making mats or bottle covers.

Propagation: Rootstocks or seed.

Burreeds (Burflag, Oxtongue)

Burreeds grow in moist locations in all parts of the northern United States. A few species are aquatic, but most species are found in marshy locations. The most common and useful species is the giant burreed, which is found over all the Northeast and the northern part of the Western and Pacific Coast States (fig. 19). The vigorous and dense growth of giant burreed protects pond banks and gives a good cover for wildlife. Its nutlike fruits are eaten by ducks and other wildlife. A disadvantage of this plant is that its growth may become so vigorous as to smother out other more valuable smaller plants.

Propagation: Rootstocks or small plants.

Arrowheads (Wapato, Arrowleaf, Duckpotato)

There are a number of plants in this group, and they are found in moist locations in almost all sections of the United States. The most common species include the broadleaf arrowhead (fig. 19,*A*), found over the Northeast, Southeast, and Pacific States; the variableleaf arrowhead in the Northeast; and the Delta duckpotato in the Southeast. The arum-leaved arrowhead, a western species of the broadleaf group, may be used. Other less common species may be more valuable locally than the ones mentioned. A few species of arrowheads are distinctly aquatic plants.

Arrowheads will grow on sand or where the original topsoil is thin, but they usually thrive best in silt or muck. They grow rapidly and

form a soil cover quickly in the spring, growing from seed or bulbs. They make good cover for small animals, particularly ducks. The seed and bulbs provide food for wildlife. The principal disadvantage of arrowheads is that they die down quickly at the close of the frost-free season and offer little cover for the soil or for the protection of wildlife after that time. Occasionally in the South they are so prolific that they crowd out other plants.

Propagation: Rootstocks, bulbs, plants, or seed.

Barnyard Grass (Wild Millet, Duck Millet, Billion-Dollar Grass)

Barnyard grass, or duck millet, is a name for several closely related grasses of the eastern part of the United States. The plants survive if subjected to flooding or drought, form good, quick cover for soil and wildlife protection, and furnish winter food to wildlife, especially ducks. Barnyard grass is particularly useful in covering mud flats at the pond inlet. The plants will grow on relatively thin soil if moisture is available. As the species are all annuals they are likely to be replaced largely by perennial plants. These grasses are tolerant of acid soil.

Propagation: Seed.

R6–39; TEX 1417; TEX 1418

FIGURE 19.—Typical marsh plants: *A*, broadleaf arrowhead; *B*, hardstem bulrush; *C*, giant burreed.

Wildrice

Wildrice may be found in shallow lakes and along fresh-water streams from Lake Winnipeg to the Gulf of Mexico and eastward from the Rocky Mountains to the Atlantic Coast. It occurs naturally in shallow water that has enough circulation to prevent stagnation. Its greatest value is as duck food, but it should provide good cover for wildlife where it can be established. Wildrice seems difficult to maintain in time of drought or in locations subject to great fluctuations in water levels from season to season. It is seldom a heavy seed producer, and on most small ponds other species of plants may surpass it in value. Wildrice commands a high price as a human food.

Propagation: The seed cannot be kept in dry storage. To retain its viability it must be kept in a wet state at a temperature that will prevent fermentation and control germination.

Cordgrass (Prairie Grass, Sloughgrass, Ripgut)

The most important species of cordgrasses are the prairie cordgrass and the alkali cordgrass. Their total range covers almost every State in the United States. Other species are found along the seacoast. For pond plantings the cordgrasses are useful in locations where heavy cutting or deposition might be expected. Plantings must be made in deep soil. These grasses make good cover but produce only a little food for wildlife.

Propagation: Rootstocks, sod, or seed.

Saltgrass

Saltgrasses are principally western species. They provide excellent ground cover. Since they are tolerant of drought and alkalinity, they may be useful on western ponds, where water levels fluctuate. They are fair waterfowl food plants.

Propagation: Rootstocks or plants.

Cutgrass (Cane Grass)

This grass is found over all the United States but is most common along the Mississippi and its tributaries. It is usually found on deep, fertile soil or silt. It is principally valuable for its heavy growth of coarse stems and leaves, which are good cover and protection to banks, and for its seeds, which are valuable bird food.

Propagation: Plants, rootstocks, or seed.

Whitetop Grass

This is a grass adapted to the northern Plains, where it makes a good cover for the soil. It is probably of considerable value in providing nesting shelter for waterfowl. This plant is fairly drought resistant.

Propagation: Plants.

Reed Canary Grass

This grass is found over most of Northeastern, Western, and the Pacific Coast States. It is a vigorous clump-forming grass and makes a good soil cover. The clumps form excellent wildlife cover, and the seed is eaten by birds. The plants will grow in slightly acid soil.

Propagation: Plants.

Canes

The giant southern cane and small cane both grow in the southeastern part of the United States. They have high ornamental value, make excellent bank protection and wildlife cover, and provide material for various handicrafts. They often crowd out more valuable species.

Propagation: Plants, in deep moist soil.

Reed

This plant occurs over the whole country. It makes a dense growth and may be useful in holding silt at pond inlets. Its vigorous growth and rapid spread sometimes make it undesirable because it may crowd out more valuable plants. It forms excellent shelter for marsh birds and waterfowl but is of little value as a source of food.

Propagation: Rootstocks.

Bulrushes (Tules) and Sedges

The rushes are among the most valuable marsh plants. Some of the species may be found in moist locations in nearly all parts of the United States. Among the most common species are the three-square rushes, whose range covers almost the entire country. Three-square is often grown on sand and in alkaline situations.

The common three-square is the most useful of this group. Its range covers the whole country. It is an excellent wildfowl-food plant and ranks high as a producer of food for muskrats. This species spreads rapidly on favorable sites but apparently seldom becomes a serious competitor of other plants. The plant is sometimes known as chairmaker's rush, for it is used in making seats.

MO 882

FIGURE 20.—River bulrush is one of the better marsh plants for protecting dams and catching silt.

The river bulrush (fig. 20) has triangular stems and broad grasslike leaves. In the East, this species may be used on dams and in pond inlets. It is a good wildlife-shelter plant but is not much used for food. It sometimes crowds out other desirable species.

A western form, the alkali bulrush, is of greater value to wildlife and thrives on alkaline shores.

The hardstem (fig. 19, *B*) and softstem bulrushes, often called tules, occur over most of the country. They are round-stemmed and usually grow taller than the species already named. In this group also is the California bulrush. These plants are excellent in the protection of dams and eroding shores, particularly the hardstem bulrush, which stands up well in the winter. They, likewise, create effective barriers to silt movement. These bulrushes form dense clumps that harbor nesting songbirds, marsh birds, waterfowl, and muskrats. The seeds are an excellent food for ducks, and the stems

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FIGURE 21.—Plantings of pondweed and spikerush help to protect the shores of this farm pond.

and rootstocks are eaten by muskrats. Muskrats often build their houses of these bulrushes.

Of the several species of nutgrasses, the chufa only is recommended for pond plantings. These plants are grasslike but are related to the sedges and rushes. They produce tubers or ground nuts, which are eaten by man as well as by wildlife. The seeds are minute and of little value.

Sedges are common over the whole United States, generally along water-courses and lakes. They are difficult to identify. The seeds are always enclosed in an inflated covering, which distinguishes these plants from others in this group. Many birds eat the seeds.

Spike rushes are relatives of the bulrushes, sedges, and chufas. They are usually less than 2 feet high and consist of thick, upright masses of small single stems with a compact spike of seeds at the top. The common spikerush, slender spikerush, square-stemmed spikerush, and dwarf spikerush make up a group that is found almost everywhere

in moist locations in the United States. In pond plantings the spikerush (fig. 21) is of value because of its hardiness and sod-forming ability. In addition, the seeds are of value as food, and the plants are good cover for small forms of wildlife. They also provide food for wild geese.

Slender spikerush is resistant to acidity, common and dwarf spikerush are tolerant to alkalinity. Only perennial spikerushes should be planted.

Propagation: Rootstocks, plants, cuttings, tubers, or seed of species readily available.

Pickerelweed

Pickerelweed is a native of the Northeast and Southeast States only. It has a blue spike of flowers but otherwise looks like arrowhead, having a heart-shaped leaf. It usually is not so valuable a plant as arrowhead, but its seeds are eaten by ducks and the plants by muskrats, and it has high ornamental value.

Propagation: Plants, rootstocks, or seeds.

Sweetflag (Calamus, Flag Root)

An aggressive plant on shores in the Eastern and Central States, the sweetflag is an excellent shore stabilizer and silt catcher. This plant often is a successful competitor of other marsh plants, sometimes crowding them out. It is an excellent food plant for muskrats but is little used by ducks. The plant has some domestic and other economic values. The roots may be candied or used for medicinal purposes.

Propagation: Rootstocks.

Smartweeds

These plants are found in moist locations everywhere in the United States. Some species can live in alkaline situations; others in acid or brackish soils. Among the better species for pond planting are nodding smartweed, water and marsh smartweeds, largeseed and dotted smartweeds. Most of the plants are annuals, and usually these are the best to plant around ponds, since they produce great quantities of cover and food for wildlife. They are particularly valuable as producers of waterfowl food. Smartweeds are excellent honey plants.

Propagation: Seed.

Lippias

Two species of these plants are common, the fogfruit and mat grass. Fogfruit is common over the northeastern part of the United States, and mat grass is found in almost every State. The value of these plants is in the dense, low mat of vegetation they form over moist soil. They should not be used where much silting is expected or where tall plants might be expected to grow. On low shores and dams they are sometimes useful.

Propagation: Plants or rooted runners.

Waterwillow

Waterwillow is found in the Northeastern and Southeastern States. It is probably most valuable in the western part of its range. It will

withstand slightly acid and moderately alkaline situations. Of the marsh plants this one is among the most tolerant of drought. It is especially useful in inlets. Waterwillow is highly ornamental when in flower and offers much wildlife cover, including protection for young fish.

Propagation: Plants or rootstocks.

Waterprimrose

Waterprimrose is of greatest value in the Mississippi Valley. It is a vigorous viny plant that floats on the water or lies flat on the mud and roots at every node. Many forms of wildlife feed on the water insects that develop on it. It is tolerant of moderate acidity and slight alkalinity. During droughts it may live on dry soil for weeks. This makes it a useful plant on ponds having fluctuating water levels. It is also an aquatic plant, for it can root in water 2 feet deep and float out over deeper water.

Propagation: Plants.

AQUATIC PLANTS

Muskgrasses (Moss, Stonewort)

The muskgrasses, so called because of their strong odor when removed from the water, appear like beds of moss beneath the surface of the water. They are grayish green and often are covered with a crust of lime. The plants do well over the entire country in waters of high lime content. The fine leaves often appear beaded. The small, white tubers are eaten by large numbers of ducks. Twenty-two species are known to feed on them, and from 200,000 to 333,000 fruiting bodies have been found in a single stomach. Muskrats, likewise, feed on muskgrasses. Although the plant sometimes becomes a pond pest, it is one of the few that can be safely recommended in the Southeast, for it seldom harbors mosquito larvae. Fish foods are common on this plant. It is not particularly good as a wave breaker.

Propagation: Plants.

Pondweeds (Duckgrass, Duckmoss, Pond Plant)

The true pondweeds (*Potamogeton*) are widely distributed and are represented by about 40 species in the United States. Among the better species are the sago pondweed, leafy pondweed, longleaf pondweed, variableleaf pondweed, small pondweed, and claspingleaf pondweed. Others are of local value. The fruits of pondweeds resemble grape clusters and are covered by a greenish skin. The leaves vary widely, ranging from almost threadlike to broad egg-shaped. The egg-shaped leaves usually float on the surface. Several of the pondweeds produce tubers that are eaten by waterfowl. These plants are of value as wave breakers, and there are records of 34 species of waterfowl having eaten them. They grow in a wide variety of conditions, the sago pondweed being one of the most tolerant of brackish or alkaline waters. The sago pondweed, longleaf pondweed, and several others sometimes become pond pests in very clear waters.

Wigeongrass, ditchgrass, or duckgrass, is an excellent wildfowl food plant, confined inland to the western half of the country. It grows in salty waters and is tolerant of considerable alkalinity and a

wide variety of soils. The plant resembles sago pondweed except for swollen leaf sheaths and separate stalks for the fruits. It is a fairly good wave breaker.

Horned pondweed or moss occurs over the whole country. It resembles the fine-leaved species of the true pondweeds, but the seeds are curved and beaked, usually growing from the stem immediately above the leaves. It tolerates considerable brackishness or alkalinity and is useful, therefore, in the West. Twenty species of waterfowl are known to feed on horned pondweed. In shallow water it is a fair wave breaker.

The bushy pondweeds also are known as bushy pond plants or naiads. They grow in shallow waters and tolerate some brackishness and alkalinity. Twenty species of ducks have been reported as feeding on these plants. They may be used over the entire country as wave breakers.

Propagation: Plants, seeds, winter buds, leafy stems, rootstocks, or tubers.

Arrowheads

Since many of the arrowheads will grow in water to a depth of 2 feet or more, they serve as aquatic plants as well as marsh plants. They act as wave breakers (see front cover) and provide shade for fish. (See Arrowheads, p. 22.)

Waterweeds

Waterweeds are often used in small aquariums for the oxygenation of the water. They have long stems with whorls of leaves. Waterweed is of little recorded value to waterfowl and of only fair value as a producer of fish-food animals. This plant has some ornamental value but often becomes so vigorous that it chokes the pond. The plant ranges across the northern portion of the country.

Propagation: Leafy stems.

Wildcelery (Duckcelery)

The long, ribbonlike leaves of wildcelery do not resemble cultivated celery. The plant may sometimes be confused with burreed or arrowhead, but the fine parallel veins running the whole length distinguish it from arrowhead, and the cell-like pattern caused by venation in burreed is distinctive of that plant. Spirally coiled fruitstalks also aid in identifying wildcelery. The wildcelery is an excellent waterfowl food, found principally in the Northeast and the north-central parts of the country. To do best, the plant requires a slight current and a coarse, gravelly bottom.

Propagation: Seed, winter buds, or rootstocks.

Duckweeds (Ducks meat)

Duckweeds are floating, tiny green plants adapted to quiet, shady waters. They sometimes become so abundant that they shade out other plants in the pond. They are good waterfowl-food plants and are eaten by muskrats. Since they grow in quiet waters they are of little value in reducing wave action.

Propagation: Plants.

Smartweeds

Although smartweeds have been discussed (p. 27), several are considered aquatic plants, among which are water smartweed, marsh smartweed, and waterpepper. In the water the smartweeds act as wave breakers. The heavy seed production supplies an abundance of excellent duck food.

Waterlilies (Lotus, Fanworts, Watershield, Spatterdocks)

Although the plants in the waterlily group are excellent as wave breakers, they are not recommended for widespread use because of their tendency to spread over the pond, shading out other species and making fishing or bathing difficult. They are the most ornamental of the aquatic plants and have economic value as such. They are of little value to waterfowl, but the beds are much frequented by fish. The lotus occurs over the eastern half of the country and is attractive for its large, yellow flowers, but it is one of the most aggressive of this group. Fanworts are southern plants. They are used in small aquariums. The watershield, an aggressive plant occurring over much of the country, has purple flowers, and the seeds have been reported as eaten by 22 species of ducks. The banana waterlily, a southern plant, is a fair duck food plant. Other true waterlilies have sweet-scented white, pink, or blue flowers. Spatterdocks are relatively unattractive, yellow-flowered plants of the East.

Propagation: Rootstocks or seed.

Coontail (Hornwort, Cedar Moss)

Coontail occurs over the whole country. While this plant varies greatly in form, particularly with regard to density of the leaves, the common name perhaps best describes the plant. It is considered a good waterfowl-food plant and may be used in aquariums. This plant, like many other aquatic plants, sometimes becomes overabundant in small ponds.

Propagation: Bushy tips of plants.

Water Buttercups (Crowfoot)

The small flowers, which may frequently cover portions of a pond, make the water buttercups attractive ornamentals. Their extremely heavy growth makes them undesirable in many ponds. They should be used only where no other valuable aquatic plants will grow. The foliage and seeds are eaten by 10 species of ducks. The plant makes a fair wave breaker. A western species is tolerant of alkalinity.

Propagation: Plants or seeds.

Watercress

In cool, shallow waters watercress grows along shores, either floating or rooted. In northern areas watercress may be a useful addition to the plants of the pond. It may reduce wave action, but domestic use is probably its greatest value. This succulent plant is eaten by ducks and upland birds. It is often the haunt of fresh water shrimp and other fish-food animals.

Propagation: Plants.

Waterprimrose

Waterprimrose is another of the group that may be considered either as a marsh plant or an aquatic. (See p. 28.)

Watermilfoil (Parrotfeather)

Some species of watermilfoil occur over the whole country. The whorls of leaves in some of these may cause them to be confused with muskgrass or coontail. The beaded appearance of the leaves of muskgrass serves to distinguish it; the forked leaves of coontail differentiate that species from those of the watermilfoil group. Although watermilfoil has been recorded from the stomachs of 21 species of ducks, it is eaten in such small quantities that it is probably not important as a duck food. Watermilfoil is one of the few aquatic plants that continue to grow on mud flats as the water lowers. It sometimes becomes a pest in shallow ponds. The fluffy clumps are fairly effective in breaking up waves.

Propagation: Cuttings or seeds.

Bladderworts

Bladderworts are leafy plants distinguished by the bearing of small bladders. They are not considered important for waterfowl, but some persons believe them to be valuable for fish. Bladderworts are very aggressive and probably should seldom be used. The plants are known to destroy mosquito larvae to some extent.

Propagation: Plants.

WOODY AND HERBACEOUS PLANTS FOR THE UPLAND

The plants listed below are those best adapted to the upland portion of the pond area. All have some value for wildlife; some, of course, are more useful than others. Several of the plants have features that make them economically valuable or ornamental.

Plants for Gully Control

Native species of trees, shrubs, vines, and herbaceous plants from local sources are advisable for use in controlling gullies. Species in the following list are highly valuable as food and shelter for wildlife.

Trees:
- Red cedars [1] (*Juniperus* spp.).
- Pines [1] (*Pinus* spp.).
- Green ash [1] (*Fraxinus lanceolata*).
- Black locust [1] (*Robinia pseudoacacia*).
- Hackberries [1] (*Celtis* spp.).
- Persimmon [2] (*Diospyros virginiana*).

Shrubs:
- Viburnums (*Viburnum* spp.).
- Dogwoods (*Cornus* spp.).
- Chokeberries (*Aronia* spp.).
- Bayberries [1] (*Myrica* spp.).
- Wild plums [2] (*Prunus* spp.).
- Chokecherries [2] (*Prunus* spp.).
- Wild roses (*Rosa* spp.).
- Sassafras [1] (*Sassafras albidum*).

[1] Species that have commercial uses.
[2] Species that have domestic uses.

Shrubs—Continued.
- Blackberries [2] (*Rubus* spp.).
- Raspberries [2] (*Rubus* spp.).
- Elders [1 2] (*Sambucus* spp.).
- Coralberries (*Symphoricarpos* spp.).
- Indigobush (*Amorpha fruilicosa*).
- Willows [1] (*Salix* spp.).
- Sumacs (*Rhus* spp).
- New Mexico locust (*Robinia neomexicana*).

Vines:
- Myrtle (*Vinca minor*).
- Dewberries [2] (*Rubus* spp.).
- Virginia Creeper (*Parthenocissus quinquefolia*).
- Wild grapes [2] (*Vitis* spp.).

Legumes:
- Lespedezas (*Lespedeza* spp.).
- Partridge-peas (*Chamaecrista* spp.).
- Veteh (*Vicia* spp.).
- Clovers (*Trifolium* spp.).
- Sweetclover (*Melilotus* spp.).

Grasses:
- Broomsedge and other bluestems (*Andropogon* spp.).
- Barnyard grass and other wild millets [3] (*Echinochloa crusgalli* and *Setaria* spp.).
- Western wheatgrass (*Agropyron smithii*).
- Bermuda grass (*Cynodon dactylon*).
- Vine mesquite (*Panicum obtusum*).
- Switchgrass (*Panicum virgatum*).
- Bluegrasses (*Poa* spp.).
- Dropseed grasses (*sporobolus* spp.).
- Timothy (*Phleum pratense*).
- Cordgrass (*Spartina* spp.).
- Orchard grass (*Dactylis glomerata*).
- Redtop (*Agrostis alba*).
- Smooth brome [3] (*Bromus inermis*).
- Reed canary grass ((*Phaloris arundinocae*).
- Bent grasses (*Agrostis* spp.).

Crop plants:
- Sudan grass [3] (*Sorghum vulgare* var. *eudanense*).
- Barley [3] (*Hordeum vulgare*).
- Rye [3] (*Secale cereale*).
- Millets [3] (*Setaria* spp.).

[1] Species that have commercial uses.
[2] Species that have domestic uses.
[3] Annual plants that will be replaced by perennials.

Windbreak Plantings

A windbreak planted on the side of the prevailing wind reduces wave action on the pond, and wood lots planted on the upland or in the area below the dam combine the advantages of timber production, shade, and attractiveness (fig. 22). Shrubs and vines should border the windbreak, and evergreens should be included if practicable.

Trees:
- Redeedars [1] (*Juniperus* spp.)
- Pines [1] (*Pinus* spp.).
- Spruces [1] (*Picea* spp.).
- Persimmon [2] (*Diospyros virginiana*).
- Osage-orange [1] (*Maclura pomifera*).
- Papaw (*Asimina triloba*).
- Hackberry [1] (*Celtis* spp.).
- Walnuts [1 2] (*Juglans* spp.).
- Hickories [1 2] (*Carya* spp.).
- Poplars [1] (*Populus* spp.).
- Cottonwoods [1] (*Populus* spp.).
- Black locust [1] (*Robinia pseudoacacia*).
- Russian olive [1] (*Elaeagnus angustifolia*).
- Mulberries [1] (*morus* spp.).

Shrubs:
- Dogwoods (*Cornus* spp.).
- Serviceberries (*Amelanchier* spp.).
- Viburnums (*Viburnum* spp.).
- Indigobush (*Amorpha fruticosa*).
- Desertwillow (*Chilopsis linearis*).
- Bayberry [1] (*Myrica carolinensis*).

Shrubs—(Continued)
- Wild plums [2] (*Prunus* spp.).
- Wild cherries [2] (*Prunus* spp.).
- Wild roses (*Rosa* spp.).
- Blackberries [2] (*Rubus* spp.).
- Raspberries [2] (*Rubus* spp.).
- Elders [2] (*Sambucus* spp.).
- Coralberry (*Symphoricarpos orbiculatus*).
- Snowberry (*Symphoricarpos albus*).
- Wolfberry (*Symphoricarpos occidentalis*).
- Willows [1] (*Salix* spp.).
- New Mexico locust (*Robinia neomexicana*).
- Tamarisk (*Tamarix* spp.).
- Sumacs (*Rhus* spp.).
- Sassafras [1] (*Sassafras albidum*).

Vines:
- Dewberries [2] (*Rubus* spp.).
- Virginia creeper (*Parthenocissus quinquefolia*).
- Wild grapes [2] *Vitis* spp.).
- Bittersweet [1] (*Celastrus scandens*).

[1] Species that have commercial uses.
[2] Species that have domestic uses.

NEB 7671

FIGURE 22.—This young windbreak by the side of the pond reduces wave action, provides wildlife shelter, and will some day produce fence posts.

SOURCES OF PLANTING STOCK FOR PONDS

Aquatic and marsh plants are usually available from natural supplies in the immediate vicinity of the farm pond. The species discussed (pp. 22–31) are widely distributed, and a sufficient stock of many of these plants may be obtained from any well-vegetated pond, lake, or stream. The identification of these plants is usually difficult, but several Federal and State agencies can quickly identify samples sent in. Plant specimens should include flowers or fruits, leaves, and stems. A specimen may be spread out while green between two sheets of any absorbent paper, such as paper towels, and pressed under weighted boards or heavy books. When dry, the sample may be sent to the Bureau of Plant Industry or the Soil Conservation Service in the Department of Agriculture, Washington, D. C.; to the Fish and Wildlife Service, in the Department of the Interior, Washington, D.C.; or to the botany department of a State college or university.

Many marsh and aquatic plants are available at aquatic nurseries, where they are sold under a number of trade names. Lists of dealers in these plants may be obtained from the United States Department of Agriculture or the Fish and Wildlife Service.

Before planting is done, a careful survey of the pond should be made to determine whether the species of plants desired are already present. This will prevent useless cost and effort in planting them.

State and Federal nurseries can often provide a considerable variety of woody planting stock at low cost. The Clarke-McNary nurseries make available some of the woody plants otherwise difficult to obtain. Applications for trees, shrubs, and vines from State and Federal nurseries may be made through the county agent. Ornamental planting stock and many of the common trees are available at private nurseries.

MANAGING WILDLIFE IN POND AREAS

It is often desirable to manage the wildlife of the pond area (fig. 23). Increased production of desirable species may be attained through simple practices in addition to those that increase wildlife food and shelter. Some forms of wildlife create a hazard to the pond. Burrowing rodents sometimes cause dams to fail. Muskrats, pocket gophers, and woodchucks are the principal offenders. Their activities may be largely prevented if the dam is well packed during the building and well vegetated soon after it is built. Muskrats should be kept completely under control by trapping for 1 or 2 years after the construction of the dam to permit the establishment of vegetation during the time that the earth is settling. Poultry netting may be used to

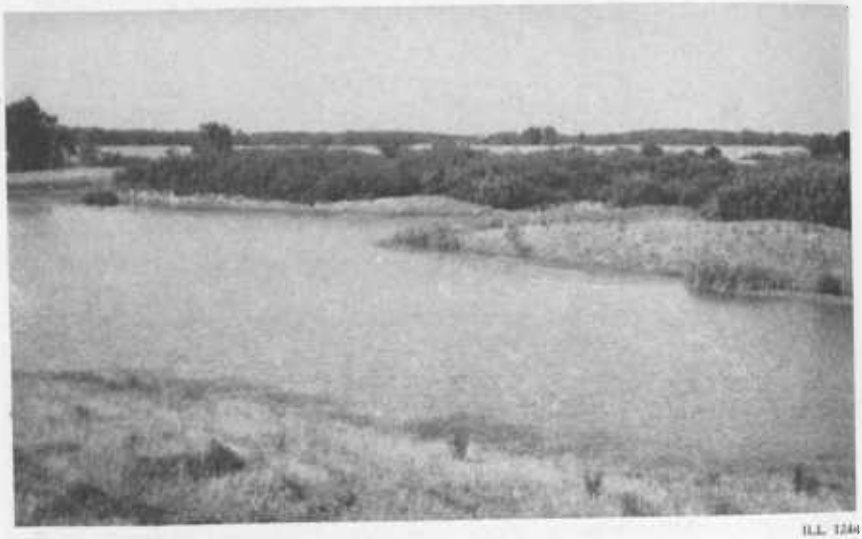


FIGURE 23.—This farm pond and its surrounding area illustrates the many uses to which one pond may be put. Erosion prevention, improved farming practices, wildlife conservation, and recreation may all be had at one pond. Compare with figure 3.

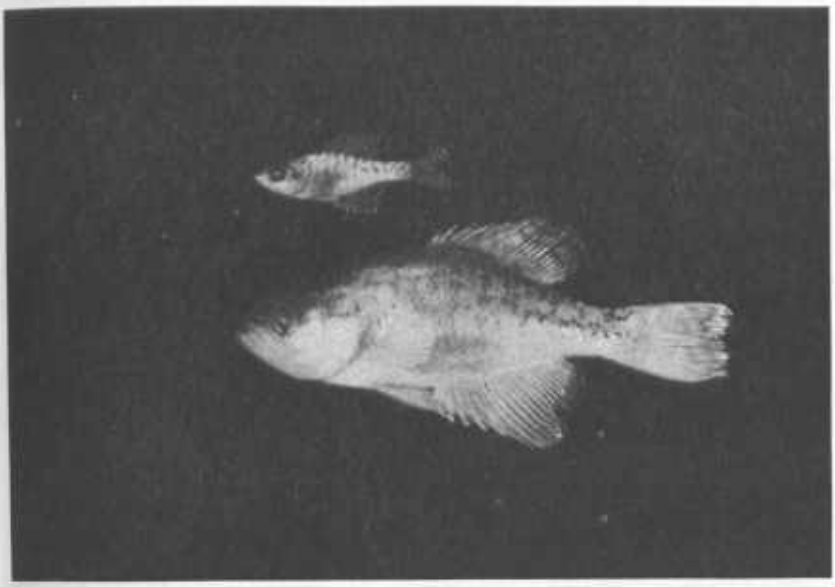
face dams having a stable water level. It may be set flat on the earth fill from the water's surface to a depth of 2 feet. A layer of sand 10 to 12 inches deep along the face of the dam likewise may help to discourage muskrats. Marsh plants help to hold the sand in place. Woodchucks and pocket gophers are readily trapped, and they may be kept out in this manner.

Crayfish, since their burrows run below the water level, sometimes cause seepage. A 6- to 8-inch layer of sand along the dam should prevent them from burrowing.

The natural controls of rodents and crayfish should be protected around the pond area. These include herons, hawks, owls, and fur animals such as the skunk, raccoon, and opossum.

Fish

Most farmers and ranchers desire to have their ponds well supplied with fish. Usually ponds are heavily stocked with fingerlings or adult fish of several species as soon as there is water in which to put them. Overstocking is almost always disappointing, for a body of water can support only a certain number of pounds of fish per acre. If a pond is overstocked the total poundage will be made up of small fish. More conservative introductions give better results (fig. 24).



TEX 1414

FIGURE 24.—Both fish are the same age and came from ponds having the same amount of food available. The upper crappie came from a pond stocked at the rate of 1,100 an acre; the lower, at the rate of 600 an acre. (Courtesy Alabama Experiment Station.)

If it is desired to obtain a considerable income from the sale of fishing privileges or other intensive harvesting of a fish crop, the objective of managing a pond is the production of as many pounds of fish per year as possible. The advice of a fish culturist should be sought for this type of fish management.

Commonly the farmer or rancher desires only an ample supply of fish to provide sport for his family and friends and to supply home needs. The management requirements for such fish production are less exacting. This bulletin deals only with this type of management.

Food

Fish production depends to a great extent on the food available, although the chemical and physical conditions of the water or the presence of disease organisms may limit production. The pond ordinarily is a completely new wildlife habitat and must therefore be developed so that food for fish is sustained. Game fish feed on

aquatic insects, snails, worms, crustaceans such as crayfish and freshwater shrimp, and other fish, as well as a host of other small animals. The species on which game fish depend for food depend themselves on plant life in the pond. The minute forms of plant life apparently provide most of the food for the animal life eaten by fish, but many of the aquatic plants are utilized.

Fertilizer for Ponds

In some sections of the country excellent production has been obtained by fertilizing ponds (fig. 25). While this is, perhaps, unnecessary where the waters drain from highly fertile soils, the less fertile waters may need treatment. Ponds on the sterile soil of gully bottoms

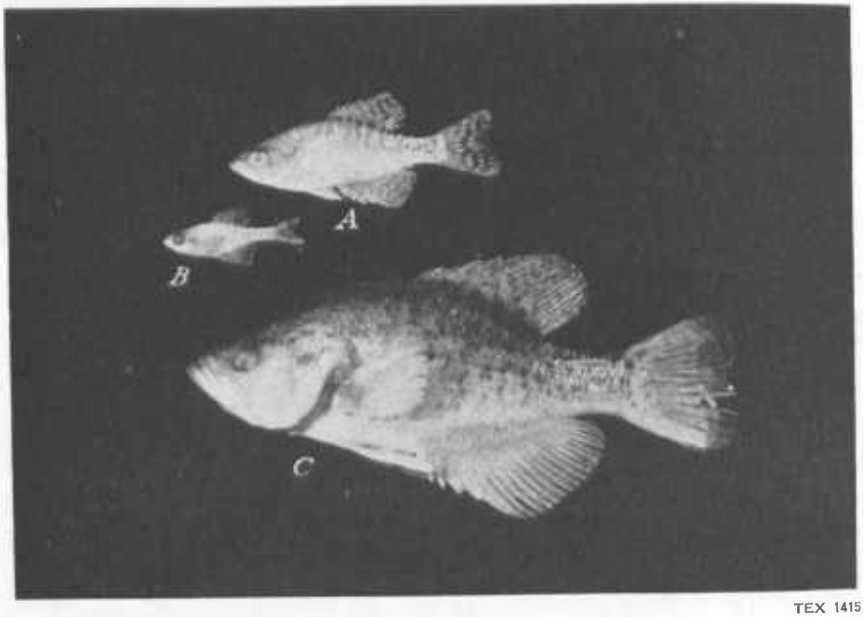


FIGURE 25.—Effect of fertilizer on fish growth. A 6-month-old crappie (*A*) from an unfertilized pond and a 6-month-old crappie (*C*) from a fertilized pond are shown above and below the fish at stocking size (*B*). The ponds were stocked at the rate of 200 fish per acre. (Courtesy the Alabama Experiment Station.)

or on shallow soils usually require a fertilizer. On the rate of fertilizing, the advice of the State fish and game department should be sought, or the State university or college may be able to supply information. In the Southeast, on ponds that have low natural fertility the fertilizer shown in the following tabulation has been used successfully.

Fertilizer mixture:	*Pounds per acre*
Sulfate of ammonia	40
Superphosphate (16 percent)	60
Muriate of potash	5
Basic slag	30
or ground limestone	15

Nine or ten such applications are made each year. The first application may be made in April or May and followed each week by

another for a period of 1 to 1½ months, then one each month thereafter until October or November.[7]

About the same results that may be expected from this fertilizer will be obtained from 100 pounds of 6–8–4 and 10 pounds of nitrate of soda at each application. Cottonseed or soybean meal and sheep manure have also been used to good advantage.

Ponds frequented by large numbers of waterfowl are often amply fertilized. Cover plantings on the upland sometimes are fertilized, and the drainage from these sites into the pond may provide supplies to insure fertile waters. Fertilized ponds may be stocked with fish at a rate two to four times that given for unfertilized ponds.

Occasionally ponds are stocked with water fleas, fresh-water shrimp, and crayfish. When the crayfish are used, only the nonburrowing forms from permanent water supplies should be obtained. If necessary, local varieties of water snails may be introduced.

Acid waters sometimes make the production of fish difficult. This may be partly offset by liming at the rate of 15 to 30 pounds an acre. Fresh cow manure is used to offset alkaline conditions.

Stocking the Pond

Depending on the fertility of the water and the bottom, the average farm or ranch pond may produce 100 to 200 pounds of fish per surface acre annually. Stocking usually should be done with fish of hatchery size, that is, about 1 to 2 inches long. All species should be the same size at time of stocking, and no large fish of any species should be used. Over much of the country, bream or sunfish, crappies, and either smallmouth or large-mouth bass are used. One recommended combination is bream and bass at the maximum rate of 400 bream to 50 bass (or crappie) per surface acre. If both bass and crappie are used, 40 crappie to 10 bass is about the right proportion. In the Northeast it may be desirable to substitute yellow perch for crappie. Occasionally bullhead catfish are stocked. The number of crappies or bass planned for stocking should be reduced for each catfish stocked. Forage fish such as the gambusia minnow, fathead or blackhead minnow, bluntnosed minnow, and golden shiner may be stocked in the pond before it is stocked with game fish at the rate of 100 per acre. Care should be taken not to permit young carp to enter the pond because carp compete with more desirable species, destroy vegetation, and are believed to destroy the eggs of other fish. There are other good forage fish, the shad for example, but many of them have undesirable features. Live transportation of shad is nearly impossible.

Ponds once properly stocked should not need further stocking, but if that becomes necessary, drain the pond and return the right numbers of small fish only.

Construction to Accommodate Fish

At the time of construction it may be desirable to excavate pools and build islands in the pond. Especially if the pond is shallow, the digging of a few deep pools is worth while. They provide cool holes in which fish may lie during the summer heat. Likewise, the plowing of the pond bottom may be done at this time. Lengthwise furrows should be left if the soil is suitable for such treatment. This creates

[7] This recommendation will be found in a mimeographed leaflet, Management of Farm Fish Ponds, issued by the Alabama Experiment Station.

more area for the production of fish foods and helps in draining the pond if that should become necessary. In areas having abundant moisture, the pond may be so constructed as to permit complete draining.

Before the pond fills with water any spawning beds to be put in for fish should be constructed. However, it is often undesirable to create conditions that may result in too large a population of fish. Since a single pair of most of the game species is capable of producing enough young to stock the average-sized pond, one or two spawning beds should suffice. For bream or blue gills the beds should be composed of fine gravel. They should be in water 1 to 4 feet deep when the pond fills. The gravel may be piled in flat-topped mounds 6 to 10 inches high and 3 to 6 feet in diameter. The gravel may be put in rough wood boxes or held in place by piling rocks around it, if necessary. Coarser gravel in beds 6 to 10 feet in diameter is suitable for bass and crappies. Spawning beds for bass should be at least 40 feet apart. Catfish will spawn under large, flat rocks, in hollow logs staked to the bottom or in old tiles. While some of the minnows spawn on aquatic vegetation, others such as the fathead, spawn under boards or flat rocks and can be managed to a certain extent by the number of spawning sites provided.[8]

Brush piles staked to the bottom of the pond provide easily constructed shelters for fish. Loose rock piles scattered over the bottom of the pond create conditions satisfactory for most small fish, and these may well be provided where plenty of rock is available. The shelters, of course, should be put in before the pond is filled. Log or board floats provide shade and shelter for the sunfishes and other species, and they may be installed after the pond is filled.

Ponds located on flowing streams often require fishways to enable the passage of fish up and down the stream. Ramps, fish ladders, or bypasses are advisable under those circumstances. If they are necessary they should always be included in the plan for the dam. The assistance of an engineer is valuable.

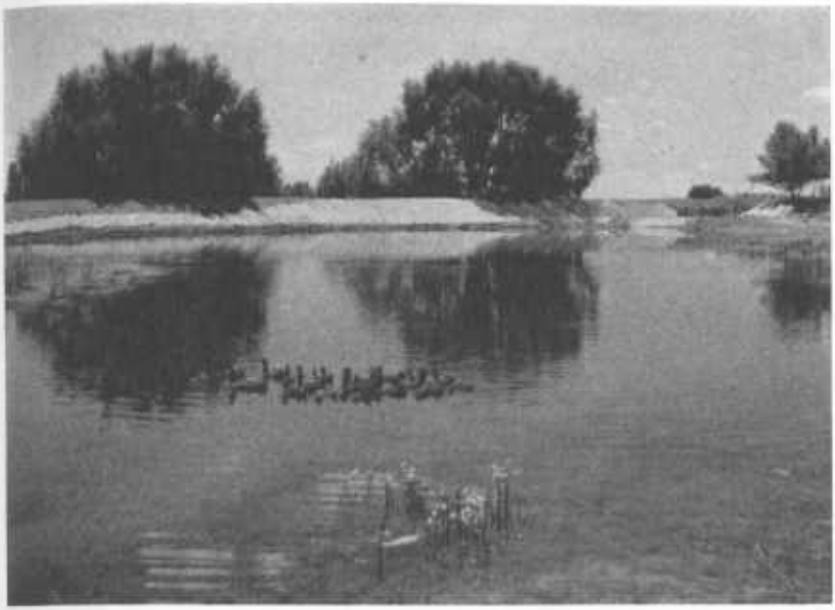
Farmers are often concerned when fish go over the spillway. This is not serious except when the pond is first stocked. A temporary hardware-cloth screen may prevent this loss until the fish become established, when it should be removed to prevent the clogging of the spillway by floating litter.

WATERFOWL

Nesting Areas

In the North, many farm and ranch ponds contribute considerably to waterfowl populations (fig. 26). The first essential in providing nesting areas for ducks is protection from livestock. The trampling and grazing of animals destroy many nests and make fencing a necessity. Some of the upland adjacent to the pond should be included within the fence and a good grass cover kept on it. This

[8] State bulletins that give detailed instructions on the construction of more complicated spawning beds and shelters are available.



TEX 23189

FIGURE 26.—Two broods of teal were raised on this ranch pond the year after its construction.

grass should not be burned at any time, for the growth of the previous year frequently creates ideal nest sites by lopping over in such a manner as to provide a shelter. Scattered low growing shrubs may enhance the value of the nesting area for mallards or pintails. Brush piles, likewise, form good temporary nest sites.

Some species of ducks, such as bluebills and ruddies, nest in marsh vegetation just above the water level. Good growths of bulrushes or cattails along low shores are desirable for these species.

Other Shelter

Marsh vegetation is desirable for the concealment of both adult and young waterfowl. Waterfowl areas should have some woody vegetation at a point near the shore to provide shade from the summer sun and protection from snow and sleet.

Low banks or islands provide loafing areas for waterfowl, and a great deal of their time is spent there. A couple of logs floating but anchored together may be provided on which the birds may loaf and preen their feathers (fig. 27). Coarse mats of fallen cattails are also used. Muskrats feed in such places.

The pond windbreak is a protection to waterfowl during severe winter weather. It should include low-growing evergreens, such as red cedars, or have dense shrub borders.

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FIGURE 27.—Old tree trunks make ideal loafing sites for ducks and are used also by muskrats and fish.

Foods

Nearly all the marsh and aquatic plants provide some food for waterfowl. Pondweeds, bulrushes, smartweeds, and wigeongrass lead all others over the country. Pond developments should include a variety of duck foods, but principally those of greater value. Locally, wildcelery, wildrice, coontail, duckweeds, muskgrasses, wild millet, horned pondweed, and bushy pondweeds are as important as pondweeds, bulrushes, smartweeds, and wigeongrass.

Snails, insects, freshwater clams, and small fish are valuable waterfowl foods. Snails may be introduced from nearby supplies if they do not become established naturally, as may be crayfish (p. 34). Ordinarily other crustaceans such as fresh water shrimps and scuds establish themselves if there is suitable vegetation in the water. Some fish hatcheries produce these species for distribution. Insects, especially water-dwelling varieties, occur naturally on aquatic vegetation. Minnows may be stocked to provide forage fish for both ducks and game fish, perhaps reducing thereby the predation on fingerlings of game species by fish-eating birds.

Gravel attracts waterfowl. If there is no gravel in the pond it is desirable to provide some. A yard of gravel scattered in small, low piles near the water will serve many ducks and other birds. Gravel should not be more than one-fourth inch in diameter, and should be composed of hard stone, such as quartz. Limestone is not satisfactory.

In many parts of the country waterfowl feed to a considerable extent on cultivated crops. Corn, sorghums, millet, and wheat are favorite foods. Locally, it may be desirable to plant food plots of these species near or within the pond area to relieve regular crop fields from raids by ducks or geese. Planting food plots is not permitted where shooting is permitted, for Federal laws prohibit the planting of cultivated crops for attracting waterfowl to shooting grounds.

Harvesting Waterfowl

Unless the area of a farm or ranch pond exceeds 5 to 6 acres, only jump-shooting should be permitted. The killing of ducks from a

blind on a small pond can result only in a devaluation of the pond as a waterfowl area and the exposure of whole flocks to destruction.

As a general rule the number of ducks taken on ponds where there has been a breeding population should be confined to an equivalent of the number produced during the year. On pond areas that do not produce waterfowl, a system of rest days may be desirable. For example, hunting may be permitted on alternate days, or a 2-day rest and 1-day hunting ratio established. This will help to preserve a breeding stock of waterfowl and yet supply ample sport for the hunter. If there are several ponds on one farm or ranch, hunting may be rotated among them, or one or two may be completely closed.

Fur Animals

Depending on the location and suitability of the farm pond to fur animals, annual crops of these animals may be harvested. The principal species produced will be the muskrat, although many others are attracted to ponds, and the pond may be a part of their home. Among these are the mink, beaver, raccoon, fox, and skunk. Only the surplus animals should be trapped. Help in determining surpluses may be obtained through the county agent.

Muskrats

Over practically all the United States the muskrat becomes quickly established in farm or ranch ponds. Even in the drier parts of the West a very small pond may yield many muskrats.

The best natural relationship of food, water, and shelter for muskrats in farm ponds occurs where there are extensive shallows at the upstream end of the pond (fig. 28). In northern areas there should be at least 3 feet of water in parts of the shallows to allow access to food in spite of freezing, but most of the habitat should be of lesser depths. A large supply of food plants, well-distributed, but not entirely covering the shallows, is essential. Small open patches of water and channels through the vegetation are desirable to enable muskrats to have ready access to all parts of the habitat and yet be amply sheltered by the plants and the water. Cattails and rushes form the staple diet of these animals, although they readily eat nearly all marsh and aquatic plants, as well as many grasses, herbs, and cultivated plants. A pond well-bordered by the larger rushes or by cattails may support 10 to 15 muskrats per acre. A pond having a considerable amount of shore line may produce more per acre than one of the same area with less shore line.

Fresh-water mussels and clams are an important source of food for muskrats, particularly in the East and Midwest. If these shellfish do not establish themselves naturally they may be stocked from local sources. Most species require a mucky bottom, and it is useless to transplant them if the bottom is hard. The source of supply should be as nearly comparable to the pond to be stocked as possible.

Muskrats usually build houses of marsh vegetation when such is available, and the same plants that provide food also supply shelter.

However, brush piles, hollow logs, and rock piles may supplement living vegetation as shelter when placed at the water's edge. Likewise, old tiles set in the banks will provide retreats. There seems to be less damage to earthen structures by muskrats when other nest sites are available.

During severe winters it may be desirable to provide supplemental food for muskrats. Alfalfa hay, carrots, apples, turnips, and corn will be readily accepted by the animals.

The harvesting of muskrats should not be done until cold weather sets in, when the pelts are worth more. In some sections of the country the muskrat is esteemed as food and is sold in markets, often under

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FIGURE 28.—A good muskrat marsh on the farm may produce many dollars' worth of pelts each year.

the name of marsh rabbit. Properly prepared, muskrats may supplement the farm table supply. It is desirable to keep a record of trapping, for overtrapping is common. If the catch shows a steady yearly decline, this is good evidence that production is not keeping pace with the take. When records show that muskrats are decreasing there should be little or no trapping for at least 1 year (p. —). The comparison in numbers of muskrat houses from year to year is a rough indication of abundance. It is probable that on the average farm pond 4 to 8 animals an acre may be harvested anually if conditions are suitable for sustained muskrat production.

Other Fur Bearers

The pond is only a part of the home area of the other fur animals. Mink may become established on the larger ponds and perhaps can be encouraged by the provision of rock piles or hollow logs near the water's edge. On the average small pond, probably only one or two mink a year can be harvested if the supply is to be maintained.

Raccoons are attracted to ponds by the presence of crayfish, frogs, and minnows. The stocking of the pond with these species, if they are not already present, should help to make the pond attractive to raccoons. Likewise, an effort should be made to preserve hollow trees within or adjacent to the pond area. Unless raccoons are exceedingly abundant, one should not take more than 1 or 2 each year at a pond or in its immediate vicinity.

The skunk is a fur animal easily attracted to pond areas. Rock piles or brush piles set back from the water on well-drained sites may provide den sites for several skunks. Frogs and crayfish are foods of the skunk, and their presence may prove an attraction. Stumps or large rocks within or near the pond area should not be removed unless farming operations require it. Care should be taken not to overtrap these animals. It may be safe to take three to five skunks near the average pond and its surrounding area, but if the catch declines, trapping should be stopped to permit the skunks to recover their numbers.

Among the general practices on pond areas that may be beneficial to fur bearers are the planting of food-producing trees and shrubs. Persimmons, grapes, papaws, cherries, plums, dogwood berries, rose hips, blackberries, and nannyberries are readily eaten by such fur bearers as the skunk, raccoon, opossum, and fox. The thickets formed by some of these plants also make admirable shelter for the animals.

Other Wildlife

In addition to the fish, waterfowl, and fur animals, the pond area usually proves attractive to upland game and other forms of wildlife. A protected area having grassy or weedy cover is almost sure to provide a nesting site for quail or other upland gamebirds or for ground-nesting songbirds such as field sparrows. In the marsh vegetation the nests of red-winged blackbirds, yellow-headed blackbirds (fig. 29), or marsh wrens usually can be found. The shrubs and vines provide shelter and nesting places for numerous species of wildlife that are both interesting and economically valuable.

Most of the means of managing waterfowl are applicable to the management of birds that frequent shore and marsh. Coots and grebes nest in the marsh vegetation on farm ponds, and many species of shorebirds are attracted there. An ample supply of marsh and aquatic vegetation produces insects and crustaceans, which, in turn, draw sandpipers, curlews, and plovers. Such species as the avocet, phalarope, and mountain plover often nest in grassy or marshy places adjacent to pond developments. A few of the shore birds are important game. Among those in this group that may frequent farm ponds are the snipe and woodcock.

There are several species of particular value especially adapted to pond areas that deserve mention. A number of animals are of economic value as bait for fishing. The farm or ranch boys may secure pocket money from the sale of earthworms, crayfish, frogs, or minnows to fishermen. The possibility of using ponds for the culture of top minnows belonging to the Gambusia group for sale to persons desiring mosquito-destroying fish is worth considering. A loamy shore can produce an abundance of earthworms. A moist site above the water line should be selected, preferably in a well-shaded spot. If leafmold

is not present, leaves, old straw or grass, or green stable manure may be spread over the site. The leafmold or other material should be spaded in and thoroughly mixed with the soil. The whole site should then be well soaked and covered with wet sacks or water-soaked boards. Further feeding may be done at 2-week intervals with 1 pound of corn meal and one-half pound of vegetable shortening or lard for each 2 to 4 square feet of the bed. They should be thoroughly mixed in the top 2 to 3 inches of soil. The bed should be kept moist but not wet.

COLO 6121

FIGURE 29.—Yellow-headed blackbirds may nest near the farm pond. This bird is one of many species attracted to ponds.

The presence of water-soaked boards or of flat rocks on the pond bottom near shore should provide shelter for nonburrowing crayfish, and the aquatic plants and their accompanying animal life will provide food.

In addition to marsh, and aquatic vegetation, old boards or logs in moist places on the shores prove attractive to small frogs suitable for bait. The boards should be slightly raised so that the frogs can go underneath. The large species of frogs, such as the bullfrog, sometimes occur in sufficient numbers to provide frog legs for home use, but unless intensively managed, ponds of the types discussed in this bulletin probably will not produce enough frogs to permit the sale of frog legs. The large frogs require well-shaded and well-vegetated shore lines where there are abundant supplies of insects, crayfish, and other foods. The arrowheads often provide conditions favorable to frogs.

There is often a market for bait minnows, and the species previously mentioned serve admirably as bait. They may be trapped or seined in the shallows of the pond.

Suitable ponds in the Southeast offer possibilities for the production of terrapins and other edible turtles. There is a market for these, and they also are used for home consumption. Further information on turtles may be secured from the Fish and Wildlife Service, Department of the Interior, Washington, D. C.

NAMES OF MARSH AND AQUATIC PLANTS TREATED IN THIS BULLETIN

MARSH SHRUBS

Buttonball bush (*Cephalanthus occidentalis*).
Cornel, roughleaf (*Cornus asperifolia*).
Cornel, silky (*Cornus amomum*).
Dogwood, creek (*Cornus californica*).
Elder, American (*Sambucus canadensis*).
Red-osier (*Cornus stolonifera*).
Willow, Bebb (*Salix bebbiana*).
Willow, black (*Salix nigra*).
Willow, sandbar (*Salix exigua, Solix interior*).

HERBACEOUS MARSH PLANTS

Arrowhead, arum-leaved (*Sagittaria cuneata*).
Arrowhead, broadleaf (*Sagittaria latifolia*).
Arrowhead, variableleaf (*Sagittaria heterophylla*).
Bulrush, alkali (*Scirpus paludosus*).
Bulrush, California (*Scirpus californicus*).
Bulrush, hardstem (*Scirpus acutus*).
Bulrush, river (*Scirpus fluviatilis*).
Bulrush, softstem (*Scirpus validus*).
Burreed, giant (*Sparganium eurycarpum*).
Cattail, broadleaf (*Typha latifolia*).
Cattail, narrowleaf (*Typha angustifolia*).
Cane, giant southern (*Arundinaria gigantea*).
Cane, small (*Arundinaria tecta*).
Chufa (*Cyperus esculentus*).
Cordgrass, alkali (*Spartina gracilis*).
Cordgrass, prairie (*Spartina pectinata*).
Cutgrass, rice (*Leersia oryzoides*).
Duckpotato, delta (*Sagittaria platyphylla*).
Fogfruit (*Lippia lanceolata*).
Grass, barnyard (*Echinochloa crusgalli*).
Grass, mat (*Lippia nodiflora*).
Grass, reed canary (*Phalaris arundinacea*).
Grass, whitetop (*Fluminea festucacea*).
Pickerelweed (*Pontederia cordata*).
Reed (*Phragmites communis*).
Saltgrass (*Distichlis stricta*).
Sedges (*Carex* spp.).
Smartweed, dotted (*Polygonum punctatum*).
Smartweed, largeseed (*Polygonum pensylvanicum*).
Smartweed, marsh (*Polygonum muhlenbergii*).
Smartweed, nodding (*Polygonum lapathifolium*).
Smartweed, water (*Polygonum amphibium*).
Spikebrush, common (*Eleocharis palustris*).
Spikebrush, dwarf (*Eleocharis parvula*).
Spikerush, slender (*Eleocharis tenuis*).
Spikerush, square-stem (*Eleocharis quadrangulata*).
Sweetflag (*Acorus calamus*).
Three-square, common (*Scirpus americanus*).
Three-square, Olney (*Scirpus olneyi*).
Waterprimrose (*Jussiaea diffusa*).
Waterwillow (*Dianthera americana*).
Wildrice (*Zizania aquatica*).

AQUATIC PLANTS

Bladderwort (*Utricularia* spp.).
Buttercup, white water (*Ranunculus aquatilis*).
Buttercup, white water (*Ranunculus circinatus*).
Coontail (*Ceratophyllum demersum*).
Duckweed (*Lemna minor*).
Duckweed, big (*Spirodela polyrhiza*).
Fanwort (*Cabomba caroliniana*).
Lotus, American (*Nelumbo pentapetala*).
Muskgrasses (*Chara* spp.).
Naiad, northern (*Najas flexilis*).
Naiad, southern (*Najas guadalupensis*).
Pondweed, claspingleaf (*Potamogeton perfoliatus*).
Pondweed, horned (*Zannichellia palustris*).
Pondweed, leafy (*Potamogeton fotiosus*).
Pondweed, longleaf (*Potamogeton americanus*).
Pondweed, sago (*Potamogeton pectinatus*).
Pondweed, small (*Potamogeton panormitanus*).
Pondweed, small (*Potamogeton pusillus*).
Pondweed, variableleaf (*Potamogeton gramineus*).
Spatterdock (*Nymphaea advena*).
Watercress (*Radicula nasturtium-aquaticum*).
Waterlilies (*Castalia odorata* and other spp.).
Waterlily, banana (*Castalia flava*).
Watermeal (*Wolffia punctata*).
Watermilfoil (*Myriophyllum spicatum*).
Waterpepper (*Polygonum hydropiper*).
Watershield (*Brasenia schreberi*).
Waterweed (*Anacharis canadensis*).
Wigeongrass (*Ruppia maritima*).
Wildcelery (*Vallisneria spiralis*).

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